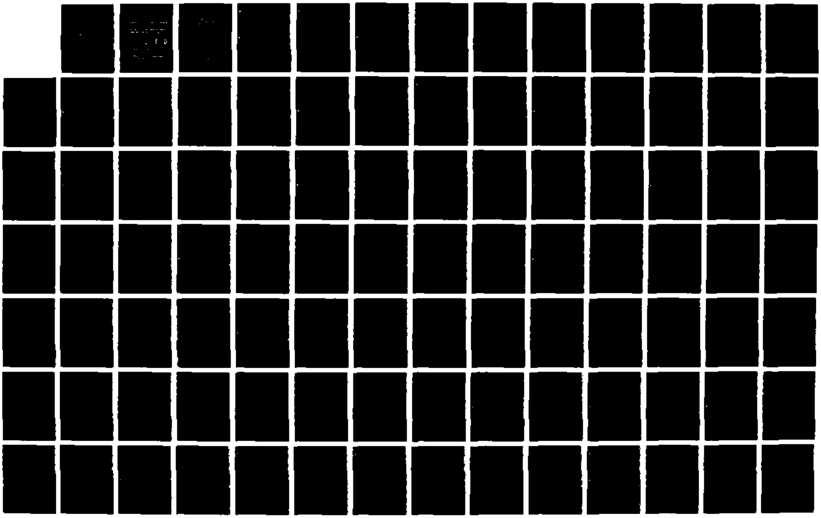
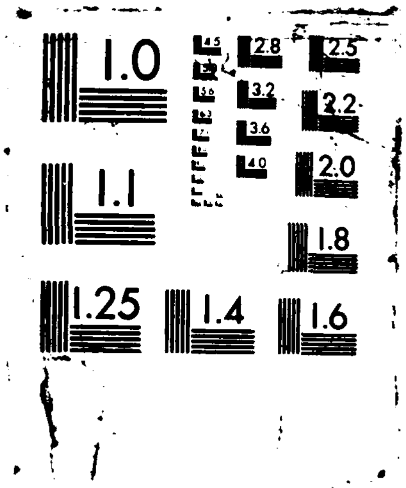
AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO CA A W BARSELL ET AL. AUG 87 GA-C-18563 1/13

UNCLASSIFIED SAPEO-CDE-IS-87006 DAAA15-85-D-0022 F/G 15/6.3 NL




1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

DTIC FILE COPY

REPORT SAPEO-CDE-IS-87008

CHEMICAL STOCKPILE DISPOSAL PROGRAM

RISK ANALYSIS OF THE DISPOSAL OF CHEMICAL MUNITIONS AT REGIONAL OR NATIONAL SITES

AUGUST 1987

PROGRAM EXECUTIVE OFFICER-PROGRAM MANAGER
FOR CHEMICAL DEMILITARIZATION

ABERDEEN PROVING GROUND, MARYLAND 21010-5401

GA-C18563

RISK ANALYSIS OF THE DISPOSAL OF CHEMICAL MUNITIONS AT NATIONAL OR REGIONAL SITES

by
GA TECHNOLOGIES INC.

Prepared under
Contract DAAA15-85-D-0022/0007
for the U.S. Army
Office of the Program Executive Officer –
Program Manager for Chemical Demilitarization
Aberdeen Proving Ground, Maryland

GA PROJECT 3813
AUGUST 1987

SECURITY CLASSIFICATION OF THIS PAGE AD-A193355

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY 2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	3. DISTRIBUTION / AVAILABILITY OF REPORT Unlimited Distribution. Approved for Public Release
4. PERFORMING ORGANIZATION REPORT NUMBER(S) GA-C18563	5. MONITORING ORGANIZATION REPORT NUMBER(S) SAPEO-CDE-IS-87008
6a. NAME OF PERFORMING ORGANIZATION GA Technologies, Inc. 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION PEO-PM Cml Demil
6c. ADDRESS (City, State, and ZIP Code) P.O. Box 85608 San Diego, CA 92138	7b. ADDRESS (City, State, and ZIP Code) Aberdeen Proving Ground, MD 21010-5401
8a. NAME OF FUNDING / SPONSORING ORGANIZATION PEO-PM Cml Demil 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) Aberdeen Proving Ground, MD 21010-5401	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)

Risk Analysis of the Disposal of Chemical Munitions at National or Regional Sites

12. PERSONAL AUTHOR(S)

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final	FROM 2/3/86 TO 8/25/87	1987, August	1152

16. SUPPLEMENTARY NOTATION

This report prepared under contract DAAA15-85-D-0022 Task Order 7.

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Chemical Stockpile, Chemical Munitions, Transportation of Chemical Munitions, Risk Analysis, Hazard Analysis, Probabilistic Risk Assessment

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This document has been prepared for the U.S. Army to support the Final Programmatic Environmental Impact Statement for the Chemical Stockpile Disposal Program. This report describes the results of a Comprehensive probabilistic assessment of the frequency and magnitude of chemical agent release for the storage, handling, on-site transportation, off-site transportation, and chemical demilitarization plant operations associated with the disposal of the chemical stockpile at two regional disposal sites or at a single national disposal site. Rail transportation from seven sites, air transportation from two sites and water transportation from one site were the off-site transportation modes analyzed. Both internal accident initiators (e.g., human error, equipment malfunction) and external accident initators (e.g., earthquakes, airplane crashes) were included in the analysis.

(Keywords) ←

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL Thomas S. Kartachak	22b TELEPHONE (Include Area Code) (301) 671-3325	22c. OFFICE SYMBOL AMCPEO-CDS

DD Form 1473, JUN 86 Previous editions are obsolete. SECURITY CLASSIFICATION OF THIS PAGE

DISCLAIMERS

The views, opinions and/or findings contained in this report should not be construed as an official Department of the Army position, policy, or decision, unless designated by other documentation.

The use of trade names in this report does not constitute an official endorsement of approval of the use of such commercial products. This report may not cited for purposes of advertisement.

ACKNOWLEDGMENT

This report is a team effort of the GA Technologies Inc. (GA) staff, H&R Technical Associates, Inc., JBF Associates, Inc., and Battelle-Columbus Division. Principal technical contributors are:

GA	H&R
A. W. Barsell	D. Crenshaw-Smith
E. A. Bellis	G. J. Malek
C. A. Bolig	W. R. Rhyne
R. K. Deremer	R. J. Robinette
C. J. Everline	P. J. Simpkins
A. J. Fraissinet	
D. M. Ligon	**JBF**
W. S. Robison	D. J. Campbell
M. G. Stamatelatos	
D. Tow	**Battelle**
	B. J. Bell
	S. E. Rose
	E. R. Zamejc

The project team thanks many other contributors not the least of which was Jen Lobner and the technical editors and typing staff. GA project management was provided by H. C. Carney and M. G. Stamatelatos. The project team greatly appreciates the review and involvement by the Office of the Program Executive Officer-Program Manager for Chemical Demilitarization, personnel of the Environmental, Safety and Surety, and Engineering and Technology Divisions, as well as by the MITRE Corporation and Oak Ridge National Laboratory.

LIST OF ABBREVIATIONS

AAF	Army Air Field
AMC	Army Materiel Command
ANAD	Anniston Army Depot
APG	Aberdeen Proving Ground
BCS	bulk chemical storage
BDS	bulk drain station
BRA	brine reduction area
BSA	buffer storage area
BSR	burster size reduction
CAMDS	Chemical Agent Munition Disposal System
CASY	chemical agent storage yard
CCDF	complementary cumulative distribution function
CHE	cargo handling equipment
CONUS	continental United States
CSDP	Chemical Stockpile Disposal Program
DARCOM	U.S. Army Materiel Development and Readiness Command
DATS	drill and transfer system
Decon	decontaminate/decontamination
DFS	deactivation furnace system
DoD	Department of Defense
DPE	demilitarization protective ensemble
DPG	Dugway Proving Ground
DUN	dunnage incinerator
ECR	explosive containment room
ECV	explosive containment vestibule

EIS	environmental impact statement
EMP	electromagnetic pulse
EPA	expected peak acceleration
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FMEA	failure modes and effects analysis
GA	GA Technologies Inc.
HAZOP	hazard and operability analysis
HF	handling operation at the facility
HC	handling operation related to onsite transportation
HP	high pressure
H&R	H&R Technical Associates, Inc.
HRA	human reliability analysis
IE	initiating event
JACADS	Johnston Atoll Chemical Agent Disposal System
LASH	lighter aboard ship
LBAD	Lexington-Blue Grass Army Depot
LIC	liquid incinerator
LPF	leakers processing facility
LPG	liquified propane gas
MDB	munitions demilitarization building
MDM	multipurpose demilitarization machine
MDE	mine demilitarization equipment
MHA	munitions holding area
MHI	munitions holding igloo
MIG	mine glove box
MIN	mine machine
MITRE	The MITRE Corporation
MLD	master logic diagram

MMI	Modified Mercalli Intensity
MPF	metal parts furnace
NA	not applicable
NAAP	Newport Army Ammunition Plant
NDC	National Destruction Center
NOAA	National Oceanic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
OFC	offsite transport container
ONC	onsite transport container
OPMCM	Office of the Program Manager for Chemical Munitions
ORNL	Oak Ridge National Laboratory
PAS	pollution abatement system
PBA	Pine Bluff Arsenal
PEO-PM Cml Demil	Program Executive Officer-Program Manager for Chemical Demilitarization
PI	periodic inspection
PM	periodic maintenance
PMD	projectile/mortar disassembly
PRA	probabilistic risk assessment
PUDA	Pueblo Depot Activity
RDC	Regional Destruction Center
RDS	rocket drain system
RSM	rocket shearing machine
SAI	Science Applications International Corporation
SEAOC	Structural Engineers Association of California
SMI	storage monitoring inspection
SNL	Sandia National Laboratory
SSE	safe shutdown earthquake
SSI	safety in storage inspection
ST	spray tank

TC	ton container
TEAD	Tooele Army Depot
TECOM	Test and Evaluation Command
THERP	Technique for Human Reliability Analysis
TOX	toxic cubicle
UBC	Uniform Building Code
UMDA	Umatilla Depot Activity
UPA	unpack area

CONTENTS

ACKNOWLEDGEMENT iii

LIST OF ABBREVIATIONS iv

EXECUTIVE SUMMARY S-1

1. INTRODUCTION 1-1

1.1. Background 1-1

1.2. Study Objectives and Scope 1-6

1.3. Demilitarization Activities and Safety Concerns 1-8

1.4. Study Assumptions 1-10

1.5. Report Format 1-12

1.6. References 1-15

2. RISK ASSESSMENT METHODOLOGY 2-1

2.1. Overview 2-1

2.2. Initiating Events 2-4

2.3. Scenario Development and Logic Models 2-5

2.4. Human Factors 2-13

2.5. Release Characterization 2-14

2.6. Uncertainty Analysis 2-16

2.7. References 2-20

3. DEMILITARIZATION DESCRIPTION OVERVIEW 3-1

3.1. Collocation Disposal Activities and Risks 3-1

3.1.1. Storage 3-3

3.1.2. Handling 3-3

3.1.3. Onsite Transport 3-6

3.1.4. Offsite Transport - Rail 3-7

3.1.5. Offsite Transport - Air 3-7

3.1.6. Offsite Transport - Ship 3-7

3.1.7. Plant Operations 3-8

3.1.8. Decommissioning 3-9

3.2. Munitions Description 3-10
3.2.1. Rockets 3-10
3.2.2. Land Mines 3-10
3.2.3. Projectiles and Mortars 3-12
3.2.4. Bombs 3-12
3.2.5. Spray Tanks 3-12
3.2.6. Bulk Agent 3-13
3.3. Munition Packaging and Transport 3-14
3.4. References 3-18
4. INITIATING EVENTS 4-1
4.1. Initiating Event Identification and Selection . . . 4-1
4.2. Initiating Event Frequencies 4-22
4.2.1. External Events 4-22
4.2.2. Electromagnetic Radiation 4-47
4.2.3. Internal Events 4-52
4.3. References 4-56
5. SCENARIO LOGIC MODELS FOR STORAGE 5-1
5.1. Sequence List and Event Trees 5-1
5.2. External Events 5-21
5.2.1. Tornadoes and High Winds 5-21
5.2.2. Meteorite Strikes 5-36
5.2.3. Aircraft Crashes 5-41
5.2.4. Earthquakes 5-51
5.2.5. Lightning 5-59
5.2.6. Floods 5-62
5.3. Special Handling Activities 5-66
5.3.1. Leaking Munitions 5-66
5.4. Scenario Quantification 5-72
5.5. Uncertainty Analysis 5-102
5.5.1. Overview 5-102
5.5.2. Error Factors 5-102
5.6. References 5-107

6. SCENARIO LOGIC MODELS FOR HANDLING 6-1
6.1. General Handling Procedures and Assumptions 6-2
6.1.1. Rail Option 6-2
6.1.2. Air Transport Option 6-4
6.1.3. Marine Option 6-5
6.2. Chronology of Handling Operations 6-6
6.3. Accident Scenarios for Handling Associated with Rail Transport 6-13
6.3.1. Human-Reliability Analysis for Handling Operations 6-19
6.3.2. Data and Results 6-28
6.4. Analysis for Air Transport 6-66
6.5. Analysis for Marine Transport 6-66
6.6. References 6-83
7. SCENARIO LOGIC MODELS FOR PLANT OPERATIONS 7-1
7.1. Internal Events 7-1
7.1.1. Explosive Containment Room Vestibule and Munitions Corridor 7-3
7.1.2. Munition Processing Systems 7-13
7.1.3. Buffer Storage Area 7-18
7.1.4. Toxic Cubicle 7-22
7.1.5. Incinerator Systems 7-25
7.1.6. Accident Analysis Summary and Results . . . 7-64
7.2. External Events 7-70
7.2.1. Tornadoes and High Winds 7-70
7.2.2. Meteorite Strikes 7-85
7.2.3. Aircraft Crashes 7-88
7.2.4. Earthquakes 7-94
7.2.5. Quantification of Logic Models 7-110
7.3. References 7-133
8. SCENARIO LOGIC MODELS FOR TRANSPORT 8-1
8.1. Onsite Transport 8-4
8.1.1. Chronology of Operations 8-4
8.1.2. Procedures and Assumptions 8-5
8.1.3. Accident Scenario for OFC and Vault Transport 8-7

8.1.4. Accident Scenarios for ONC Transport . . . 8-31

8.1.5. Analytical Results 8-32

8.2. Offsite Rail Transport 8-49

8.2.1. Accident Scenario Definition 8-49

8.2.2. Rail Transport Procedures and Data 8-51

8.2.3. Event Tree Analysis 8-58

8.3. Offsite Air Transport 8-86

8.3.1. Procedures and Assumptions 8-86

8.3.2. Accident Scenario Definition 8-89

8.3.3. Accident Sequence Analysis 8-91

8.4. Offsite Marine Transport 8-109

8.4.1. Procedures, Assumptions, and Data 8-109

8.4.2. Accident Sequence Definition and Analysis 8-110

8.5. Uncertainty Analysis 8-129

8.6. References 8-141

9. QUANTIFICATION BASES 9-1

9.1. Data Base 9-1

9.1.1. Train Accident Data 9-1

9.1.2. Onsite Truck Accident Data 9-6

9.1.3. Plant Accident Data 9-11

9.1.4. Handling Accident Data 9-25

9.2. Human Factors Data 9-27

9.2.1. Human-Error Probability Estimation - Handling Accidents 9-27

9.2.2. Human-Reliability Analysis for Plant Operations 9-31

9.3. References 9-54

10. AGENT RELEASE CHARACTERIZATION 10-1

10.1. Release Analysis Approach and Bases 10-1

10.1.1. Approach 10-1

10.1.2. Mechanical Failure Release 10-2

10.1.3. Detonations 10-7

10.1.4. Fire Release 10-9

10.1.5. Release Duration 10-12

10.2. Application to Accident Sequences 10-17

10.2.1. Handling 10-17

10.2.2. Warehouse Storage Release During Earthquakes 10-20

10.2.3. Plant Operation Releases 10-24

10.2.4. Transport Releases 10-35

10.2.5. Uncertainties 10-40

10.3. References 10-45

11. RESULTS 11-1

11.1. Accident Scenarios During Storage 11-2

11.1.1. Internal Events 11-2

11.1.2. External Events 11-2

11.2. Accident Scenarios During Handling 11-4

11.2.1. Rail Option 11-4

11.2.2. Air Option 11-6

11.2.3. Marine Option 11-6

11.3. Accident Scenarios During Operation 11-8

11.3.1. Internal Events 11-8

11.3.2. External Events 11-9

11.4. Accident Scenarios During Transport 11-10

11.4.1. Onsite Transportation 11-10

11.4.2. Offsite Transportation - Rail 11-12

11.4.3. Offsite Transportation - Air Option 11-13

11.4.4. Offsite Transportation - Marine Option . . 11-14

11.5. Uncertainties 11-16

11.5.1. Sources of Uncertainty 11-16

11.5.2. Uncertainties 11-17

APPENDIX A: REFERENCE LIST OF ACCIDENT SCENARIOS A-1

APPENDIX B: SENSITIVITY ANALYSIS B-1

APPENDIX C: STRUCTURAL ANALYSIS C-1

APPENDIX D: SITE INFORMATION D-1

APPENDIX E: (DELETED)

APPENDIX F: MUNITION FAILURE THRESHOLDS F-1

APPENDIX G: DEMILITARIZATION ACTIVITIES G-1

APPENDIX H: (CLASSIFIED INFORMATION) H-1

APPENDIX I: TABULATED ACCIDENT SEQUENCE RESULTS I-1
APPENDIX J: SUPPORTING INFORMATION FOR HANDLING ANALYSIS . . . J-1

FIGURES

1-1. Location of chemical agents and munitions in the U.S. . . 1-2
1-2. Logistic phases associated with the munitions storage and disposal options 1-9
2-1. Outline of risk assessment procedure used in this study 2-2
2-2. Accident scenario development using an event tree 2-6
2-3. A fault tree model of a power system failure 2-8
2-4. Definition of fault tree symbols 2-9
2-5. Impact of assumptions on the accident frequency uncertainty assessment 2-18
3-1. Activities associated with munitions handling and transport 3-2
4-1. Master logic diagram - level 1 (public impact) for the collocation options of the chemical demilitarization cycle 4-5
4-2. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part A - storage release 4-6
4-3. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part B - handling release 4-7
4-4. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part C - onsite storage release 4-8
4-5. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part D - plant operations internal events 4-9
4-6. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part E - plant operations external events 4-10
4-7. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part F - offsite rail transport 4-11
4-8. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part G - offsite air transport 4-12

FIGURES (Continued)

4-9. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part H - offsite sea transport 4-13

4-10. Seismic zone map for the contiguous United States 4-26

4-11. Annual frequency of exceeding various effective peak accelerations for locations on the indicated contours . . 4-28

4-12. Tornadic winds corresponding to a probability of 1.0×10^{-7} per year 4-31

4-13. Tornadic winds corresponding to a probability of 1.0×10^{-6} per year 4-32

4-14. Tornadic winds corresponding to a probability of 1.0×10^{-5} per year 4-33

4-15. Wind strength versus probability of recurrence, tornado Zone I (TEAD and UMDA sites) 4-34

4-16. Wind strength versus probability of recurrence, tornado Zone II (PUDA and APG sites) 4-35

4-17. Wind strength versus probability of recurrence, tornado Zone III (ANAD, LBAD, PGA, and NAAP sites) . . . 4-40

4-18. Field intensity potentially hazardous to susceptible weapons which require special restriction - communication frequencies 4-50

4-19. Field intensity potentially hazardous to susceptible weapons which require special restrictions - radar frequencies 4-51

5-1. Agent release indicated by tornado-generated missiles . . 5-11

5-2. Meteorite-induced agent release 5-12

5-3. Large aircraft crash onto storage igloos containing burstered munitions 5-13

5-4. Aircraft crash onto storage facilities with nonburstered (NB) munitions 5-14

5-5. Aircraft crash accidents involving munitions in holding area (rail option) 5-15

5-6. Aircraft crash accidents involving munitions in holding area (air option) 5-16

5-7. Aircraft crash accidents involving munitions in holding area (marine option) 5-17

5-8. Aircraft crash accidents involving the lighters at rest (marine option) 5-18

FIGURES (Continued)

5-9. Aircraft crash accidents involving the LASH at rest (marine option) 5-19

5-10. Earthquake-induced agent releases involving munitions in storage igloos 5-20

5-11. Earthquake-induced releases from the warehouses 5-54

6-1. Flow diagram for handling operations, collocation option 6-8

6-2. Handling activities for ship transport option 6-9

6-3. Event tree for drop of munition(s) during handling at facility 6-14

6-4. Event tree for drop of munition(s) during handling operations other than at facility 6-15

6-5. Event tree for forklift tine punctures during handling 6-16

6-6. Event tree for vehicle collisions during handling at facility 6-17

6-7. Event tree for vehicle collisions during handling other than at facility 6-18

7-1. Event tree for spill of one rocket in ECV 7-6

7-2. Event tree for spill of one ton container in ECV 7-7

7-3. Event tree for spill of two ton container in ECV 7-8

7-4. Event tree for detonation of burstered munition in ECV . 7-9

7-5. Fault tree for agent release through the ventilation systems 7-10

7-6. Event tree for spill of munition(s) in the ECR 7-15

7-7. Event tree for detonation of burstered munitions in the ECR 7-16

7-8. Event tree for spill of munition in MPB 7-17

7-9. Event tree for detonation of one ton container in in the BSA 7-23

7-10. Event tree for a small spill in the TOX 7-26

7-11. Event tree for a large spill in the TOX 7-27

7-12. Fault tree for failure to suppress a fire in the TOX . . 7-29

7-13. Event tree for LIC-1 initiators 7-34

7-14. Event tree for LIC-1A initiators 7-35

7-15. Event tree for LIC-2 initiators 7-36

FIGURES (Continued)

7-16. Event tree for LIC-2A initiators 7-37

7-17. Event tree for LIC-3 initiators 7-38

7-18. Event tree for LIC-4 initiators 7-39

7-19. Event tree for LIC-4A initiators 7-40

7-20. LIC room ventilation fault tree 7-41

7-21. Filtered exhaust fault tree 7-42

7-22. Fault tree for LIC fuel flow termination 7-43

7-23. Fault tree for terminating fuel flow to LIC burners . . . 7-44

7-24. Fault tree for LIC agent feed termination 7-45

7-25. Fault tree for LIC PAS shutdown 7-46

7-26. Event tree for LIC PCC fuel flow termination 7-47

7-27. Control and solenoid valve fault trees 7-48

7-28. LIC room explosion fault tree 7-49

7-29. Fault tree for fuel flow forming a flammable mixture in the LIC room 7-50

7-30. Fault tree for draining bulk containers 7-51

7-31. Event tree for MPF shutdown 7-52

7-32. Event tree for unpunched bulk item fed to MPF 7-53

7-33. MPF room ventilation fault tree 7-54

7-34. MPF room filtered exhaust fault tree 7-55

7-35. Fault tree for MPF fuel flow termination 7-56

7-36. Fault tree for failure to stop fuel to MPF burners . . . 7-57

7-37. MPF room explosion fault tree (loss of offsite power) . . 7-58

7-38. Fault tree for feeding an unpunched container to the MPF 7-59

7-39. Tornado-induced agent release scenarios 7-74

7-40. Meteorite-induced agent release scenarios 7-75

7-41. Large aircraft crash onto MHI/MDB containing burstered munitions 7-76

7-42. Aircraft crash onto MHI/MDB with nonburstered (NB) munitions 7-77

7-43. Event tree: earthquake-induced releases from the MDB involving bulk containers 7-78

FIGURES (Continued)

7-44. Event tree: earthquake-induced releases from the MDB involving burstered munitions 7-79

7-45. Extrapolated seismic hazard model 7-99

7-46. TOX fragility model 7-101

7-47. Phenomenological fault tree for ignition occurrence . . . 7-102

7-48. Phenomenological success tree for fire suppression . . . 7-104

8-1. Diagram of transportation steps and options (sending sites are APG for marine shipment, APG or LBAD for air transport, and all nondisposal sites for rail transport 8-2

8-2. Event tree for onsite transportation (truck accident) . . 8-8

8-3. Event tree for onsite transportation (aircraft crash) . . 8-16

8-4. Event tree for onsite transportation (earthquake) 8-19

8-5. Event tree for tornado-caused collision/overturn during onsite transportation 8-26

8-6. Event tree for tornado-generated missile affecting onsite transportation 8-27

8-7. Cumulative distribution of fire durations for train-tanker accidents and locomotive fires 8-56

8-8. Impact velocity distribution for large packages in train accidents 8-57

8-9. Cumulative distribution of total crush load for a large package in train accident 8-59

8-10. Event tree for train accident caused by earthquake or human error/equipment failure 8-60

8-11. Event tree for air transportation 8-90

8-12. Approximate duration of fuel fire as a function of aircraft size and on-board fuel inventory 8-95

8-13. Event tree for marine vessel collision initiating event 8-113

9-1. Probability of failure to isolate room by X min 9-44

9-2. HRA event tree of fire suppression model 9-46

TABLES

3-1. Data for onsite transport containers (ONC), vaults, and offsite transport containers (OFC) 3-11

TABLES (Continued)

4-1. Accident sequence coding scheme 4-4

4-2. Initiating event families for storage 4-15

4-3. Initiating event families for handling 4-16

4-4. Initiating event families for onsite truck transport . . 4-17

4-5. Initiating event families for plant operations 4-19

4-6. Initiating event families for offsite rail, air, or sea transport 4-21

4-7. Site specific frequencies of external initiating events 4-23

4-8. External event frequencies for special cases 4-24

4-9. Maximum modified Mercalli intensities in the vicinity of each site 4-25

4-10. Annual risk of earthquakes 4-29

4-11. Tornado windspeeds and probability of recurrence for chemical storage sites 4-36

4-12. Wind generated missile parameters 4-37

4-13. Windborne missile velocities 4-38

4-14. Aircraft crash probabilities near airports 4-43

4-15. Assumed distribution of air traffic 4-44

4-16. Summary of aircraft crash probabilities 4-46

4-17. Size distribution of meteorites which are 1 lb or larger 4-48

4-18. List of internal initiating events and frequencies . . . 4-53

5-1. Master list of storage accidents 5-3

5-2. Windborne missile velocities 5-9

5-3. Munition penetration through steel igloo doors 5-24

5-4. Munition penetration through concrete igloo doors . . . 5-26

5-5. Probability of a wind hazard sufficient to breach munitions in storage magazines 5-27

5-6. Probabilities for wind-generated missile penetration of ton containers and spray tanks stored in ware-warehouses and open storage 5-28

5-7. Windborne missile velocity (holding/loading area - rail/air option) 5-30

TABLES (Continued)

5-8. Probability of a wind sufficient to generate missiles to beach munition (holding/loading area - rail/air option) 5-33

5-9. Probability of missile striking munitions in holding/loading area (rail/air option) 5-34

5-10. Tornado-generation missile analysis of the barge package 5-35

5-11. Meteorite required for penetration of munitions in storage 5-37

5-12. Summary of aircraft crash probabilities 5-40

5-13. Data base for aircraft crash-initiated scenarios for storage 5-46

5-14. Data base for analysis of earthquake-induced agent release in the storage igloos 5-53

5-15. Earthquake-induced accidents in warehouses 5-55

5-16. Site-specific lighting strike information 5-61

5-17. Probable size distribution for steel tanks 5-64

5-18. Data base for analysis of SL1, SL2, and SL9 5-70

5-19. Frequencies of storage accident sequences 5-73

5-20. Frequency of earthquake storage accidents per year . . . 5-88

5-21. Generic uncertainty models 5-103

6-1. List of accident scenarios (HC and HF) collocation option - rail transport 6-20

6-2. Initiating events frequencies (handling associated with rail transport) 6-28

6-3. Conditional events probabilities (rail transport) . . . 6-30

6-4. Handling accident-collocation processing option (rail transport) 6-36

6-5. Initiating event frequencies (handling associated with air transport) 6-68

6-6. Conditional events probabilities (air transport) 6-70

6-7. Handling accident - collocation processing option (air transport) 6-73

6-8. Accident scenarios for marine transport option handling activities 6-79

6-9. Initiating and conditional events frequencies (marine transport) 6-80

TABLES (Continued)

6-10.	Barge transport option	6-82
7-1.	Events considered for the ECV/munitions corridor	7-11
7-2.	Events considered for the munition processing systems .	7-19
7-3.	Events considered for the BSA	7-24
7-4.	Events considered for the TOX	7-28
7-5.	LIC initiating event descriptions	7-33
7-6.	Internal events accident sequences	7-65
7-7.	Plant operations internally-initiated accident sequence frequencies (events/year)	7-66
7-8.	Master list of externally-initiated plant accident scenarios	7-71
7-9.	Data base for tornado-initiated events for plant operations	7-83
7-10.	Event 5 statistical parameters	7-109
7-11.	Data base for meteorite initiated plant accident sequences	7-111
7-12.	Effective target area for aircraft crash analysis . . .	7-112
7-13.	Aircraft crash data	7-113
7-14.	Plant operations data	7-117
8-1.	Onsite transport sequence 1	8-11
8-2.	Onsite transport sequence 2	8-12
8-3.	Onsite transport sequence 3	8-12
8-4.	Onsite transport sequence 4	8-13
8-5.	Onsite transport sequence 5	8-14
8-6.	Onsite transport sequence 6	8-17
8-7.	Onsite transport sequence 7	8-18
8-8.	Onsite transport sequence 9	8-21
8-9.	Onsite transport sequence 10	8-22
8-10.	Onsite transport sequence 11	8-23
8-11.	Onsite transport sequence 12	8-24
8-12.	Onsite transport sequence 13	8-25
8-13.	Onsite transport sequence 14A	8-28
8-14.	Onsite transport sequence 14B	8-29
8-15.	Onsite transport sequence 15	8-30

TABLES (Continued)

8-16. Onsite transportation - regional and national disposal options 8-33

8-17. Onsite transportation - onsite package - collocation option 8-42

8-18. Travel miles for rail transport 8-53

8-19. Rail transportation data 8-54

8-20. Rail transport sequence 1 8-62

8-21. Rail transport sequence 2 8-63

8-22. Rail transport sequence 3 8-64

8-23. Rail transport sequence 4 8-65

8-24. Rail transport sequence 5 8-66

8-25. Rail transport sequence 6 8-67

8-26. Rail transport sequence 7 8-68

8-27. Rail transport sequence 9 8-69

8-28. Rail transport sequence 10 8-70

8-29. Rail transport sequence 11 8-71

8-30. Rail transport sequence 12 8-72

8-31. Rail transport sequence 13 8-73

8-32. Rail transport sequence 14 8-74

8-33. Rail transport sequence 15 8-75

8-34. Offsite rail transportation - national disposal option 8-76

8-35. Offsite transportation - regional disposal option . . . 8-81

8-36. Accident scenarios for air transport to Tooele Army Depot 8-92

8-37. Distribution of aircraft accident impact categories . . 8-96

8-38. Summary of aircraft accident threat frequency data . . . 8-100

8-39. Air transport sequence 1 8-103

8-40. Air transport sequence 2 8-104

8-41. Air transport sequence 3 8-105

8-42. Air transport sequence 4 8-106

8-43. Air transport sequence 5 8-107

8-44. Sequence frequencies for air transportation 8-108

8-45. Summary of offsite marine transport sequences 8-115

TABLES (Continued)

8-46. Frequency of agent release for the lighter in the Chesapeake Bay 8-119

8-47. Frequency of agent release for the ship in the Chesapeake Bay 8-120

8-48. Frequency of agent release for the ship in the coastal areas 8-122

8-49. Frequency of agent release for the ship on the high seas 8-123

8-50. Frequency of accidents without a release for the ship on the high seas 8-124

8-51. Frequencies of offsite marine transport accident sequences 8-126

8-52. Uncertainty data for the onsite truck transportation (in onsite package) accident sequences 8-130

8-53. Uncertainty data for onsite truck transportation (offsite package) accident sequences 8-132

8-54. Uncertainty data for offsite rail accident transportation sequences 8-135

8-55. Uncertainty data for offsite transportation by air accident sequences 8-138

8-56. Uncertainty data for onsite truck transportation accident sequences (marine option) 8-139

9-1. Comparison of 1972 and 1982 accident data 9-3

9-2. 1982 train accident data by category 9-4

9-3. Train accidents caused by track, roadbed, and structure defects 9-7

9-4. Train accidents caused by mechanical and electrical failures 9-8

9-5. Train accidents caused by human factors 9-9

9-6. Train accidents caused by miscellaneous factors 9-10

9-7. Truck accident rate 9-12

9-8. Human error probabilities per handling operation 9-28

9-9. Screening quantification for human reliability analysis of plant operations 9-33

9-10. Human-error events by sequence 9-35

9-11. Human-error events for final quantification 9-39

9-12. THERP quantification of fire-suppression model 9-47

TABLES (Continued)

10-1. Agent release times for fires and detonations 10-14

10-2. Grouping of handling sequences according to agent release characteristics 10-18

10-3. Inventory data for onsite and offsite transport containers 10-19

10-4. Agent releases (pounds) for handling sequences 10-21

10-5. Agent HD releases from ton containers stored in UMDA warehouses during earthquakes 10-25

10-6. Agent VX releases from NAAP warehouse ton containers during earthquakes 10-26

10-7. Agent VX release from spray tanks stored at TEAD warehouses during earthquakes 10-27

10-8. Agent inventories and releases 10-32

10-9. Results of agent release for onsite transport accident sequences (marine option) 10-36

10-10. Results of onsite transport release analysis - air option 10-37

10-11. Release consequences for the air transport mode 10-41

10-12. Marine transport agent releases 10-42

EXECUTIVE SUMMARY

S.1. INTRODUCTION

S.1.1. Background

Under the direction of the U.S. Army Office of the Program Executive Officer-Program Manager for Chemical Demilitarization (PEO-PM Cml Demil), GA Technologies Inc. (GA) and its subcontractors performed a comprehensive assessment of the frequency and magnitude of accidental agent releases associated with various alternatives under consideration for the Chemical Stockpile Disposal Program (CSDP). This assessment was carried out in support of the environmental impact statement (EIS) for this program and addresses only the stockpile of chemical munitions that is currently stored at eight sites in the continental United States (CONUS). The assessment of potential health consequences to the public resulting from accidental releases calculated in this study will be performed in a separate study. These consequences and the GA-evaluated frequencies of the releases leading to these consequences will form the basis of estimates of the potential public "risks" associated with the CSDP alternatives.

The alternatives investigated in this study are as follows:

1. Disposal of the agents and munitions at the eight existing storage sites.

2. Collocation (transportation) and disposal of the munitions at two regional sites.

3. Collocation and disposal of the munitions at a single national site.

4. Partial collocation of the selected stockpiles from Aberdeen Proving Ground (APG) to Johnston Island by water or to Tooele Army Depot (TEAD) by air and from the Lexington-Blue Grass Army Depot (LBAD) to TEAD by air.

5. Continued storage of the munitions at the existing storage sites.

This report addresses the collocation alternatives listed above (i.e., items 2, 3, and 4). The other alternatives are discussed in separate reports.

Anniston Army Depot (ANAD) in northeast Alabama and TEAD in north central Utah have been identified as the regional disposal sites should this collocation alternative be selected. If the national collocation alternative is selected, the disposal facility will be constructed at TEAD.

Demilitarization of the chemical agent and munition stockpiles requires the construction of facilities and planned activities to store, handle, and transport onsite the chemical materiel; to transport the agents and munitions between sites if a collocation alternative is selected; to destroy the munitions; and to decommission the disposal facilities. This report addresses each of these activities, other than facility construction and closure, which do not pose risk to the health and safety of the general public from agent release.

S.1.2. Study Objectives and Deliverables

The primary objectives of the study reported in this document were to:

1. Identify events that could initiate the release of agent to the environment (i.e., initiating events).

2. Develop the various sequences of events resulting from these initiators and leading to accidental agent release.

3. Perform a quantitative analysis of the frequency of occurrence of each relevant accident sequence.

4. Characterize the physical state, quantity, and duration of agent released from each accident sequence.

These objectives were accomplished by developing a list of potential accident sequences for each major activity, estimating the frequencies of these sequences, and calculating the magnitudes of released agent associated with these sequences. It should be noted that only accident sequences that survived a conservative screening process, considering both frequency and magnitude of agent release, are included in the deliverables of this project.

S.1.3. Scope of Study

The scope of effort reported in this document, as noted earlier, did not include the evaluation of agent dispersion to the environment and the consequences to the public resulting from such releases. As such, the title of this report is more appropriately that of a probabilistic "release" analysis as opposed to a probabilistic "risk" analysis, since risk is usually defined as the product of frequency and consequence. Therefore, the term "risk," as used in this study, refers to

the frequency of accidental agent release and not to the frequency of the agent release consequence to public health.

S.1.4. Plant Description

Demilitarization of the chemical munitions stored at U.S. sites is based on the Johnston Atoll Chemical Agent Disposal System (JACADS) technology. This facility is currently being constructed on the Johnston Atoll in the Pacific Ocean. The demilitarization facility consists of an integrated munitions handling system that can process a variety of munitions types and agents. After disassembly and draining of the munitions, the agent, explosive materials, dunnage, and metal mass are subjected to different combustion trains where the combustibles are consumed by incineration. All materials are subjected to two-stage incineration, and combustion products are released to the environment through a state-of-the-art pollution abatement system.

Two types of demilitarization plants will be constructed: mixed-munition plants and bulk agent plants. Mixed-munition plants are capable of processing all types of chemical materiel. Bulk plants are designed to process ton containers, bombs, and spray tanks. For the national disposal alternative, three mixed-munition plants and two bulk agent plants will be constructed at TEAD. For the regional disposal alternative, two mixed-munition plants and one bulk agent plant will be constructed at TEAD, and one mixed-munition plant and one bulk agent plant will be constructed at ANAD.

To meet the September 1994 deadline for the destruction of the chemical agent stockpile, the plants are projected to begin operation during the period between September 1990 and March 1991. The plants will operate five days per week and twenty-four hours per day.

The analysis of plant operations presented in this assessment was based on a plant design which was approximately 35 percent complete.

It is recognized that design evolution could have an impact on the results reported herein.

S.1.5. Site Descriptions

There are eight sites in the CONUS where chemical munitions are currently being stored. These sites are: Tooele Army Depot (TEAD), Anniston Army Depot (ANAD), Aberdeen Proving Ground (APG), Lexington-Blue Grass Army Depot (LBAD), Newport Army Ammunition Plant (NAAP), Pine Bluff Arsenal (PBA), Pueblo Depot Activity (PUDA), and the Umatilla Depot Activity (UMDA).

TEAD is located in north central Utah. A prototype demilitarization plant, the Chemical Agent Munitions Disposal System (CAMDS) facility, is located at this site. The site currently stores a wide variety of chemical munitions and bulk agent containers of mustard and the nerve agents, GB and VX.

ANAD is located in northeast Alabama. The chemical munitions stockpile at ANAD consists of all chemical munitions types except for bombs, spray tanks, and 8-in. projectiles filled with VX.

APG is located in Maryland near the head of the Chesapeake Bay. APG is comprised of two general areas, the Aberdeen area and the Edgewood area where the chemical munition storage facilities are located. Only mustard-filled ton containers are stored at APG.

LBAD is located south of Richmond, Kentucky. The chemical munition stockpile at LBAD consists of 8-in. projectiles, 155-mm projectiles, and M55 rockets.

NAAP is located west of Indianapolis, Indiana. The chemical munitions stockpile is stored there in a single warehouse and consists of containers of VX.

PBA is located southeast of Little Rock, Arkansas. The stockpile at PBA consists of M55 rockets, land mines, ton containers, and some 4.2-in. mortar projectiles.

UMDA is located in northeastern Oregon. The stockpile at UMDA consists of 155-mm and 8-in. projectiles, M55 rockets, M23 land mines, bombs, spray tanks, and ton containers.

S.2. STUDY APPROACH

The risk analysis presented in this report combines the structured safety analysis detailed in MIL-STD-882B (Ref. S-1) and the probabilistic approach outlined in NUREG/CR-2300 (Ref. S-2). The first reference requires that hazards analyses be performed to assess the risk involved during the planned life expectancy of a system. It also provides guidance on the categorization of hazard severity and of probability as a means of identifying which hazards should be eliminated or reduced to an acceptable level. The second reference serves as a guidebook for the risk assessment of nuclear power plants.

Risk assessment can be defined as the quantification of an undesirable effect in probabilistic terms. Relative to the health and safety of the public, the effects of interest are injuries and deaths. Risk assessment has been utilized in various industries for some time. Insurance companies have long used actuarial data for statistical evaluations to justify differences in the insurance premium paid by persons in different "risk" categories. The risk assessments performed for nuclear power plants, on the other hand, are examples of major industry efforts to quantify risks of low-frequency events for which no good actuarial data exist. The nuclear power plant risk assessments have become models for other industrial risk assessments.

S.2.1. Risk Assessment Methodology

Probabilistic risk assessment (PRA) is a systematic, disciplined approach to quantifying the frequency and consequences of events which can occur at random points in time. In its application to the various chemical munition disposal alternatives currently under consideration, PRA provides a comprehensive framework for estimating and understanding the risks associated with the storage, handling, transportation, and demilitarization activities associated with these alternatives. By applying this methodology to each alternative in a consistent and uniform manner, a statement of the relative risk of these alternatives can be made. Because of the significant uncertainties in the data used to quantify the frequency of occurrence of various accident sequences and the magnitudes of the associated agent releases, extreme caution must be used when addressing the absolute risk associated with each disposal option.

In simplistic terms, the PRA process focuses on answering the following three basic questions:

1. What can go wrong?
2. How frequently is it expected to happen?
3. What would be the associated consequences?

The remainder of this summary describes how these questions are addressed in the risk assessment of the chemical materiel disposal program. In this study, the estimation of consequences is limited to the magnitudes of agent release for each sequence.

S.2.1.1. Identification of Initiating Events. The first step in a probabilistic risk assessment is the identification of initiating events which, by themselves or in combination with additional failures, can lead to the release of agent to the environment. Initiating events are identified for each of the demilitarization activities. Such events

generally fall into two broad categories known as "internal" events and "external" events. Internal events originate within the activity and are caused by human error or random equipment failure. Examples of such events are the dropping or puncture of munitions during handling operations, and the random failure of a normally operating piece of equipment in the demilitarization process line. The class of events referred to as external includes aircraft crashes and natural phenomena such as earthquakes and storms. In the context of a risk assessment, events such as internal flooding and fires are also considered to be external events. External events are usually pervasive in nature in that they are assumed to fail redundant equipment that is provided for safe shutdown of the operation and containment of the agent.

S.2.1.2. Accident Sequence Development. Once initiating events are identified, logic models (such as event trees and sequence level fault trees) are developed to display the various paths that the accident can take. For example, an initiating event such as spurious shutdown of an incinerator will not result in a significant release of agent to the environment unless numerous ventilation and automatic shutdown systems fail. In most cases, the probability of failure of multiple systems is so low that the frequencies of such accident sequences are too low to be of any concern. Furthermore, because of inherent system inertia and engineered safety features which are provided, there may be ample time to recover and repair mitigating* systems prior to any release.

As suggested above, operator intervention can influence the course of an accident, and therefore his role must be included in the logic models where appropriate. Of course, operating and emergency personnel also have a significant influence on the potential for and amount of accidental agent release.

---

*"Mitigation" as used in this report is the act of preventing or limiting the consequence of an accident that has occurred.

S.2.1.3. Human Interactions. Human interactions, or interventions, of interest to the chemical munitions disposal risk assessment fall into one of the following six general categories:

1. Initiation of an accident by committing an error (e.g., a munitions handler punctures or accidentally drops a munition).

2. Test and maintenance actions (e.g., a valve is disabled or left in the wrong configuration following a test or maintenance act).

3. Termination of an accident by correctly implementing established emergency procedures (e.g., an operator terminates agent feed to the liquid incinerator when automatic termination has failed).

4. Aggravation of an accident by taking incorrect action (e.g., a plant operator misdiagnoses the nature of the accident and performs an act which causes the accident to have greater consequences).

5. Termination of an accident by actions which are outside the scope of existing procedures (e.g., based on his knowledge of the plant or process, a plant operator performs an act which is not covered by procedures and terminates or mitigates the accident).

6. Intentional acts to initiate accidents or render equipment in a failed state (sabotage).

Human interactions that fall in the first three categories are modeled either as a separate event heading in the event tree or as an independent event in the fault tree which is used to model and quantify

the event in the event tree. Human interactions defined by categories 4 and 5 above are difficult to quantify and as such are not given much attention in a risk assessment.

Acts of sabotage (category 6) are outside the scope of this analysis and will be addressed elsewhere.

S.2.1.4. Agent Release Characterization. The consequences of an agent-release event are dependent on the type of agent, the magnitude of the release, the mode and duration of the release, the dispersion of the agent to the environment, the demographic characteristics of the region impacted by the release, and the toxicity of the dispersed agent at the concentration levels to which members of the public are exposed. The scope of effort reported in this document is limited to the first three characteristics listed above. Agent dispersion to the environment and subsequent effects on humans are addressed elsewhere in a separate report.

The characterization of agent release required a systematic review of the potential modes of agent release from its normal confinement. The first result of this review was the separation of the accident scenarios into two categories: (1) scenarios that occur while the agent is contained in the munition; and (2) scenarios that occur after the agent is separated from the munition. For the munition-dependent accident scenarios, the agent release mechanism is dependent on the particular mechanical, thermal, and explosive behavior of the munition, assuming the occurrence of an initiating event such as dropping during handling or aircraft crash, as well as the confinement which is provided, if any. Scenarios included in the second group are limited to those which occur during the actual demilitarization process (i.e., plant operations).

After determining that agent could be released in a particular accident sequence and that the frequency of that sequence exceeded the threshold screening frequency, an analysis was performed to identify the

possible paths by which the agent could be released to the environment and to estimate the quantity of agent released.

S.2.1.5. Sequence Screening. The implementation of PRA methodology in terms of event trees can produce a large number of potential accident sequences. In order to reduce this to a manageable number to focus on the critical scenarios for analysis, the accident sequences are screened for frequency or consequence. By using conservative values for the conditional probabilities of event tree branches, it is possible to show that many of the possible sequences are of sufficiently low frequency (e.g., less than 10^{-10} per year) that they need not be addressed further. In addition, if an accident sequence has a frequency greater than the threshold screening frequency but results in an insignificant release of agent* to the environment, it can also be eliminated from further consideration. The accident sequences contained in this report have been subjected to both types of screening.

S.3. RESULTS

The analysis of the potential for agent release to the atmosphere from accident scenarios related to the collocation disposal option included the following major activities: (1) storage, (2) handling activities associated with the transport of munitions, (3) onsite transportation, (4) offsite transportation, and (5) plant operations associated with the demilitarization of munitions. This section discusses some of the accident probability and agent release results associated with these activities.

*Less than 14 lbm of mustard; less than 0.4 lbm of agent VX; and less than 0.3 lbm of agent GB. These quantities represent the minimum quantities of agent release that would result in a lethal dose of agent at 500 m for the most limiting release modes (Ref. S-3).

The results of the analysis of the various activities encompassing the collocation options cannot be presented in the same units, i.e., annual frequencies, because of the possible divulgence of classified information. This is only possible for some storage and plant operation accident scenarios. For accident scenarios related to the handling activities either at the original site, the regional site, or the national site, the unclassified portion of the probabilistic analysis is given in terms of frequency of accidents per pallet of munitions (or as a container of munitions). For onsite and offsite transportation accidents, the basic results are reported in terms of accident frequency per vehicle mile. These probabilities/unit are then multiplied by the number of handling operations or vehicle miles traveled during the stockpile disposal program.

The evaluation of the actual risk to the public and environment requires agent dispersion calculations which are not in the scope of th: study reported here. Despite this limitation, the results discussed herein still provide useful insights on the contributions of the various disposal activities to the risk of an agent release. These insights are discussed below.

S.3.1. Accident Scenarios During Storage

The collocation alternative requires some storage of munitions in their existing location prior to transportation to the disposal site. In addition, it requires storage of munitions in offsite transport containers at the sending and receiving sites and some storage at the disposal site before movement to the demilitarization facility.

S.3.1.1. Internal Events. There were no significant internal event initiators of accidents during storage at the disposal site before movement to the demilitarization facility. Per unit operation, forklift drop accidents occur more frequently than forklift tine punctures.

Also, the use of a lifting beam instead of a tine leads to an order of magnitude decrease in drop frequency.

S.3.1.2. External Events. These events involve accidents caused by natural phenomena or human activity affecting munitions in storage igloos, open storage areas, holding areas, or warehouses. If these are assumed to be full of munitions, the agent inventories range up to 100, 200, 1000, and 2000 tons, respectively, for storage igloos, holding areas, open areas, and warehouses. The most frequent external accidents having significant release involve mild intensity earthquakes or small airplane crashes (order depending on site). Amounts of available agent inventories released in these events are on the order of fractions of one percent or less (munition punctures, drops, etc.).

The largest releases occur for a large aircraft crash, a meteorite strike, or a severe earthquake, especially when a warehouse (at NAAP, TEAD, or UMDA) is involved. These can result in up to 10 percent of the agent inventory released for scenarios involving a fire which has the potential (duration) for destroying the entire inventory of an igloo or warehouse. The munitions stored in warehouses contain only VX or mustard which have much slower evaporation rates than GB and hence are not easily dispersed into the atmosphere. Thus, warehouse scenarios involving only spills are not significant risk contributors. The warehouse at UMDA has the potential for the largest release. Meteorite strike-initiated sequence median frequencies are one to two orders of magnitude lower than the aircraft crash-induced sequence frequencies. As expected, munitions stored outdoors are generally more susceptible to large aircraft crashes than those stored in warehouses or igloos, but releases are lower. Both APG and PBA have ton containers stored outdoors, and the aircraft crash probabilities at these sites are somewhat higher than at the other sites. Igloos appear to provide only minimal protection from direct crashes of large planes, but releases are an order of magnitude lower. The releases are more severe if burstered munitions are involved.

S.3.2. Accident Scenarios During Handling

Included in the handling analysis are (1) single munition or pallet movements by hand, forklift, or other equipment; (2) packing or unpacking pallets into transportation containers; (3) loading and unloading packages from trucks, railcars, aircraft, or barges; or (4) loading and off-loading barges into the oceanfaring vessel (LASH).

There are twice as many handling operations at the receiving sites (RDC or NDC) involving collocated munitions that are not in any transportation container. Furthermore, there are more handling operations involving munitions in onsite transport containers (ONCs) than bare munitions or those in larger offsite transport containers (OFCs).

S.3.2.1. Handling for the Rail Alternative. The results indicate that dropped munitions, whether in palletized form or not, occur more frequently than either forklift tine puncture or forklift collision accidents. In fact, the frequency of forklift collision accidents which lead to the munitions falling off the forklift is an order of magnitude lower than the drop accidents. Furthermore, the type of clothing an operator is wearing while handling these munitions influence the drop frequency value. An operator wearing Level A clothing is more likely to commit an error that would cause the munition to be dropped than when he is wearing more comfortable clothing.

The results also indicate that spray tanks (in overpacks) have relatively higher drop frequencies than other munitions. This is largely due to the assumption that spray tanks will be lifted and moved to the truck (for loading or unloading) using forklift with tines. The drop frequency using the tines is an order of magnitude higher than with the use of lifting beams.

For bare munitions, the rockets seem to be the most prone to punctures from drops or forklift tine accidents. However, the ONC or OFC itself also affects the puncture probability. Because of its weight and larger surface area, the drop of an OFC increases the munition puncture probability by about a factor of 4 to 5 (depending on the munition type and packing density) when compared to a similar drop of an ONC. However, bare munitions have higher puncture probabilities than munitions in ONCs. This observation is of course not quite evident in the final results presented because there are more handling operations involving possible drops of ONCs than bare munitions.

Bulk items that are punctured lead to larger releases than other munitions such as projectiles or rockets. Bombs are of concern because they contain GB which evaporates more readily than the other agent types. The agent vapor releases range up to 400 lb (thermal failure of all munitions in an OFC).

Within the types of handling accidents, the events designated as HC, which are related to the packaging of munitions in ONCs or OFCs and their movement from storage (sending sites) to the munitions handling igloo (MHI) (receiving sites), predominate over handling accidents related to the facility (HF). This is largely because (1) there are more handling operations involved in the HC accidents, (2) HF accidents generally involve munitions in ONCs, which provides them with some protection from puncture, and (3) HF accidents involving bare munitions occur inside the munitions demilitarization building (MDB) which is designed for vapor containment; hence, including the probability of a detonation which destroys the vapor containment barrier, both the frequency of a release and the release itself are relatively lower.

The frequency results for the handling accidents could not be compared with the accidents from other activities, such as plant operations, because of differences in units. To get some perspective on how they compare on a yearly basis, we can estimate the number of pallets

that could be handled based on the plant annual processing rates. For illustrative purposes we calculate the number of bomb pallets that are required to meet the annual plant processing rate as:

$$5.4 \text{ bombs/h} \times 24 \text{ h/day} \times 5 \text{ day/week} \times 52 \text{ week/yr} / 2 \text{ bombs/pallet} = 16{,}848 \text{ pallets/yr} \quad .$$

By multiplying the HC1 sequence frequency for TEAD (1.2×10^{-7}/pallet) with the number of pallets/yr, the annual frequency is 2.0×10^{-3}/yr. Thus, handling accidents which lead to significant agent releases (in particular, agent GB) are dominant risk contributors because of the relatively higher annual frequency values. Of course depending on the actual munition inventory, the value of annual frequency may either increase or decrease when converted to the more meaningful per stockpile basis.

S.3.2.2. Handling for the Air Option. The accident scenarios discussed for the rail option also apply to the air option. Since the air option involves only the movement of munitions from LBAD and APG to TEAD, agent releases from 155-mm projectiles, 8-in. projectiles, rockets and ton containers are of interest. The general observations noted in the discussion of the accident frequencies for the rail option (Section S.3.2.1) also apply here. The accident release is lower for the handling of these munitions since the amounts of GB agent contained in rockets and projectiles are quite small compared to bombs.

S.3.2.3. Handling for the Marine Option. For this option, the ton containers are placed in a transportation container (vault) that is different from the OFC; hence, the handling steps are somewhat different. There are eight sequences related to handling that were identified. Sequence HW34, which involves the dropping of a lighter by a crane while loading into or unloading from the lighter aboard ship (LASH) vessel, has a relatively high frequency of 6.0×10^{-6} per shipment. The structural analysis indicates that dropping of the lighter

from a height of about 70 ft onto an unyielding surface of the LASH vessel could cause the crushing of several ton containers inside the lighter. The agent will be confined in the interior of the ship, and the amount of agent released to the atmosphere is small.

S.3.3. Accident Scenarios During Plant Operations

Included in the analysis for this phase are all malfunctions during agent processing/incineration within the MDB or external events affecting drained and undrained agent in the MDB, including those in the unpack area (UPA) (up to 10^4 lb of agent available) and munitions awaiting processing in the MHI, up to 3×10^4 lb of agent available. After unpacking, the munitions are processed by conveyor to the burster removal area, mine punch-and-drain area, projectile mortars disassembly area, rocket and burster shearing machines, mine machine for burster removal, a bulk item drain station, a toxic cubicle (TOX) agent storage tank, furnaces for explosive deactivation, metal parts decontamination, and agent and dunnage incinerators, as appropriate.

S.3.3.1. Internal Events. Because of the engineered safety features provided in the plant design, both the frequency of release and magnitude of release associated with accidents initiated by equipment failure and human error are relatively small. Among the large number of accident scenarios analyzed, the highest frequency scenario (P052) is initiated by an inadvertent feed of an unpunched burstered munition to the dunnage incinerator (10^{-2}/yr for mines; 5×10^{-3}/yr for other munitions). As a result of detonation, one burstered munition inventory is released to the atmosphere as vapor (only up to 15 lb of agent).

The largest amount of agent vapor release occurs for a metal parts furnace explosion (P044) with ventilation failure (one bulk item inventory release, up to 1700 lb). However, this scenario was assessed to have a very low frequency, around 10^{-10}/yr. Another event with up to several hundred pounds of vapor release is P048, munition detonation in

the explosive containment room vestibule with subsequent fire spreading to unpacked munitions. However, this scenario also has a low frequency, around 10^{-9}/yr.

S.3.3.2. External Events. Aircraft crashes dominate the external event frequency, and there is little difference between direct and indirect crashes. The small difference is attributed to offsetting effects. Although the indirect crash has smaller conditional probabilities of failures than the direct crash, the risk model utilizes a larger target area for the indirect crash. There is very little distinction in the frequency of aircraft crashes with or without fire, since historical data indicate that there is roughly a 50 percent chance that the crash of an aircraft will involve a fire. The frequency of a crash onto the MDB is considerably larger than that for the MHI because the surface area of the MDB is more than 30 times larger than the MHI.

The frequency of large aircraft crashes is estimated to be higher at ANAD than it is for TEAD. This impacts the regional versus national collocation option. The accident scenario involving the crash of an airplane onto the outdoor agent piping system for the modified CAMDS facility at TEAD has a frequency of about 10^{-8}/yr with up to 55 lb of vapor release. This scenario includes both large and small aircraft crashes. The frequency of small aircraft (including helicopters) crashes is at least two orders of magnitude higher than the frequency of large aircraft crashes at TEAD.

The frequencies of earthquake-induced accident scenarios are generally higher for TEAD than for ANAD since TEAD is located in a region more prone to earthquakes. Sequence P033, which represents an earthquake-initiated munition fall and fire but with the MDB and TOX intact, has the highest frequency (2×10^{-6}/yr for ANAD and 5×10^{-5}/yr for TEAD). This sequence involves the detonation of all munitions (if burstered) in the UPA since the fire is not suppressed in this sequence.

All accident sequences related to tornadoes or meteorites were estimated to occur at frequencies of less than 10^{-10}/yr and thus were screened out.

S.3.4. Accident Scenarios During Transport

S.3.4.1. Onsite Transportation. There are two truck transportation phases considered in the analysis. At the sending sites, munitions in offsite transportation packages are transported by truck to the holding area prior to loading into the train, airplane, or barge. The accidents are identified as the VR, VA, or VW (i.e., for rail, air, and water, respectively) scenarios. At the receiving sites, munitions still in off-site packages are moved to storage locations where they are removed from the offsite package and stored until they are ready for demilitarization. The accidents are also coded VR or VA. Finally, when munitions at their storage locations are ready for demilitarization, they are transferred into onsite containers and then moved by truck to the MHI. The accidents are identified as VO scenarios to distinguish between the transportation risk of using an onsite package versus an offsite package (different failure thresholds). The agent available in a truck carrying an OFC is less than 3400 lb, while up to 7000 lb is available for an ONC truck transport.

As a result of analysis for both internally initiated events (human error or equipment failure) and externally initiated events, the following conclusions were reached:

1. The offsite transportation package provides munitions with more protection from crush forces generated from truck accidents than the onsite package. Hence, sequences with OFC crush have insignificant accident frequency whereas scenarios with ONC crush have frequencies up to 10^{-8}/truck-mile.

2. Both packages provide similar protection from impact forces. The results show that accident frequencies resulting in impact failure are insignificant. This is largely due to the administrative control to be imposed during truck travel which limits truck speed to no more than 20 mph. The impact forces at this velocity are not sufficient to breach the containment.

3. The probability of puncture resulting from truck collision/overturn is at least an order of magnitude higher for offsite containers than onsite containers. This results from the higher likelihood of generating a probe sufficient to puncture the container and the munition when the accident involves a large package such as the OFC.

4. Truck accidents which generate fires are more likely to detonate burstered munitions inside onsite packages, since they provide only a 15-min protection from an all engulfing fire (versus 2 h for the OFC). However, all these scenario frequency results are also quite low because of the administrative control for limiting the amount of fuel in the truck so as not to exceed a 10-min fire.

5. When rockets are involved in the accidents which generate sufficient impact forces to cause propellant ignition, there is very little distinction in the results for the two packages.

6. For tornado-initiated accidents, puncture as a result of truck overturn is the dominant contributor to the sequence frequency.

7. Generation of undue forces during truck accidents that could cause burster detonations has a small contribution to the overall truck transportation risk.

8. The amount of agent spilled or burned during truck accidents resulting in the breach in containment by puncture forces generally involve the agent content of one munition. Up to 10 percent is released as vapor.

9. Both containers can fail when an aircraft crashes into the truck (VR6, VR7, V06, V07). The entire truckload is involved, and up to 10 percent is released as a vapor. Hence, aircraft crash-initiated truck accidents have the most severe consequences. It should be noted, however, that none of the accident sequences has a frequency greater than 10^{-7}/yr.

S.3.4.2. Offsite Transport - Rail. In this option, munitions in OFCs are transported by rail either to two regional destruction centers (RDC-ANAD or RDC-TEAD) or a single national destruction center (NDC-TEAD). The agent inventory available per railcar ranges up to 7000 lb. Results of the accident analysis indicate the following:

1. Rail accident crush and impact forces are very unlikely to fail an OFC and munition inside.

2. The major risk contribution due to mechanical failure comes from a probe such as a railcar coupler (generated from train accidents) capable of puncturing the OFC and the munition. Munition failure frequency by puncture (RC3) is about an order of magnitude higher than train accidents which lead to fire and cause the thermal detonation or rupture of munitions (RC4 and RC5). However, the consequence (i.e., agent release) from the latter sequence is more severe.

3. For tornado-initiated accidents (RC14), puncture as a result of train derailment is the dominant contributor to the agent release frequency.

4. Aircraft crash into a train can damage the munitions (RC6 and RC7). The crash can involve one or two railcars (i.e., up to four OFCs). The largest amounts of agent released are from the bulk items (bombs, ton containers, and spray tanks). A maximum of 10 percent of the inventory is released as vapor (up to 1400 lb). This is the largest release for rail scenarios.

S.3.4.3. Offsite Transport - Air Option. The air transport option applies only to the movement of ton containers from APG to TEAD, and rockets and projectiles from LBAD to TEAD. Five generic sequences related to air transport were identified. These scenarios were evaluated for both the C-141 and C-5 aircrafts. There will be approximately 1500 flights from LBAD and 300 flights from APG for the C-141 aircraft. The C-5 aircraft would decrease the number of required flights by one fourth. The analysis also differentiated among accidents which occur during takeoff, while in flight, and during landing. Each flight would carry up to 3400 lb of agent inside OFCs.

The aircraft accident frequency during landing is about seven times higher than during takeoff and about three times higher than inflight accidents. However, the failure probability of the package due to impact forces is higher inflight than either takeoff or landing. If an aircraft crash occurs, the OFC and the munitions are subjected primarily to impact forces sufficient to fail the package. The accident frequencies from sequences which involve impact only are almost of the same order of magnitude as sequences which involve impact and fire (AA1 versus AA20). The accident frequencies involving the C-5 aircraft are an order of magnitude higher than those for C-141 aircraft. A compensating factor is that there will be 75 percent fewer flights if the C-5 is used.

Accident scenarios involving fire of sufficient duration to fail the packages are not credible for the C-141 aircraft because of insufficient fuel available to sustain a fire of duration to fail the package containment.

Accidents which lead to severe impact (AA1 and AA2; AB1 and AB2) without fire have the highest frequency and also lead to the largest amounts of agent released. For severe impact release involving burstered munitions, some of the munitions contained in the aircraft will detonate, and up to just over 400 lb will be released as vapor. For accidents involving moderate impact forces, no agent release occurs from impact alone. The moderate impact accident must be accompanied by fire to fail the package thermally.

S.3.4.4. Offsite Transport - Marine Option. The marine option was analyzed only for the movement of ton containers filled with mustard at APG to the Johnston Atoll. There were five groups of initiating events identified. Impact and puncture are not the dominant failure forces experienced in marine accidents. The cargo will be adequately braced to hold it in place. Furthermore, most of the events are low-velocity, high-momentum events; hence, the dominant failure mode is crush. Fire, immersion, and aircraft crash events were also considered because of the large amount of agent being transported which could be involved in fire or sinking accidents.

The results indicate that:

1. For the lighters in the Chesapeake Bay, collision accidents are at least three orders of magnitude more probable than either rammings or groundings.

2. For the LASH vessel in the Chesapeake Bay, both grounding and collision accidents are at least one order of magnitude more probable than rammings.

3. Grounding of the LASH vessel in the coastal areas is less likely than in shallower inland waters.

4. For the LASH vessel in high seas, collision is still the predominant event. However, grounding results in more severe consequences.

The agent release analysis shows that collisions result in the largest number of ton containers (TCs) which fail (8) for barges, but that groundings or heavy weather damage results in the maximum number of TCs failed (68) for the LASH (except for aircraft crash, which is below the frequency screening threshold). The largest amount of agent vapor release to the atmosphere occurs for these worst events, and the amounts are not strongly dependent on whether fire occurs or not. Although a large inventory (up to 4 million lb on the LASH) is available, no accident leads to a release of more than 0.1 percent.

S.4. UNCERTAINTIES IN THE ANALYSIS

In assessing the risks associated with the CSDP alternatives, every effort was made to perform best-estimate analyses, i.e., "realistic" evaluation and quantification of the accident sequence frequencies and associated agent releases. The use of pessimistic or conservative modeling techniques or data for quantification violates the intent of the probabilistic nature of the study. Realistic modeling and quantification permits a balanced evaluation of risk contributors and comparison of alternatives. However, for realistic or best-estimate calculations, the obvious concern is the accuracy of the results. Uncertainty analysis addresses this concern.

S.4.1. Sources of Uncertainty

Since the event sequences discussed in Section S.3 have not actually occurred, it is difficult to establish the frequency of the

sequence and associated consequences with great precision. For this reason, many parameters in a risk assessment are treated as probabilistically distributed parameters, so that the computation of sequence frequencies and resulting consequences can involve the probabilistic combination of distributions.

There are three general types of uncertainty associated with the evaluations reported in this document: (1) modeling, (2) data, and (3) completeness.

There exist basic uncertainties regarding the ability of the various models to represent the actual conditions associated with the sequence of events for the accident scenarios that can occur in the storage and disposal activities. The ability to represent actual phenomena with analytical models is always a potential concern. The use of fundamental models such as fault trees and event trees is sometimes simplistic because most events depicted in these models are treated as leading to one of two binary states: success or failure (i.e., partial successes or failures are ignored). Model uncertainties are difficult to quantify and are addressed in this study by legitimate efforts of the analysts to make the models as realistic as possible. Where such realism could not be achieved, conservative approaches were taken.

No uncertainty from oversights, errors, or omission from the models used (e.g., event trees and fault trees) is included in the uncertainty analysis results. Including these uncertainties is beyond the state-of-the-art of present day uncertainty analysis.

The uncertainties in the assignment of event probabilities (e.g., component failure rates and initiating event frequencies) are of two types: intrinsic variability and lack of knowledge. An example of intrinsic variability is that where the available experience data is for a population of similar components in similar environments, but not all the components exhibit the same reliability. Intrinsic variations can

be caused, for example, by different manufacturers, maintenance practices, or operating conditions. A second example of intrinsic variability is that related to the effects of long-term storage on the condition of the munitions as compared to their original configuration. Lack of knowledge uncertainty is associated with cases where the model parameter is not a random or fluctuating variable, but the analyst simply does not know what the value of the parameter should be. Both of these data uncertainty types are encountered in this study.

S.4.2. Uncertainties

The sequence frequency results discussed in this report are presented in terms of a median value and a range factor of a probability distribution representing the frequency of interest. The range factor represents the ratio of the 95th percentile value of frequency to the 50th percentile (i.e., median) value of frequency. The uncertainty in the sequence frequency is determined using the STADIC-2 program (Ref. S-4) to propagate the uncertainties associated with each of the events in the fault trees or event trees through to the end result. Some scenarios, such as those associated with tornado missiles and low-impact detonations have rather large uncertainties. The difficulty with tornado-generated missiles lies with the difficulty in accurately modeling the probability that the missile will be in the proper orientation to penetrate the munition and in predicting the number of missiles per square foot of wind. The difficulty with the low-impact detonations lies with the sparse amount of data available and its applicability to the scenarios of interest. In general, uncertainties tend to be large when the amount of applicable data is small and vice versa.

S.5. REFERENCES

S-1. U.S. Department of Defense, "Military Standard System Safety Program Requirements," MIL-STD-882B, March 30, 1984.

S-2. U.S. Nuclear Regulatory Commission, "PRA Procedure Guide," NUREG/CR-2300, 1982.

S-3. Memorandum to C. A. Bolig (GA) from R. B. Perry (PEO-PM Cml Demil), May 6, 1987.

S-4. Koch, P., and H. E. St. John, "STADIC-2, A Computer Program for Combining Probability Distribution," GA Technologies Inc., GA-A16277, July 1983.

1. INTRODUCTION

1.1. BACKGROUND

The U.S. Department of Defense is required by Congress (Public Law 99-145) to destroy the stockpile of lethal chemical agents and munitions stored at eight U.S. Army installations in the continental United States (CONUS) and at the Johnston Atoll Army site in the Pacific Ocean by the end of September 1994. The locations of the CONUS sites are shown in Fig. 1-1. The total Army stockpile at these sites is made up of more than 3,000,000 items consisting of rockets, mines, mortars, projectiles, cartridges, bombs, spray tanks, and bulk containers. These munitions contain the nerve agents GB and VX and the blistering mustard agents H, HD, and HT.

The Army has developed a plan for destruction of the chemical munition stockpile. This plan is set forth in the Chemical Stockpile Disposal Concept Plan submitted to Congress in March 1986 and supplemented in March 1987. In this plan, three disposal alternatives are described:

1. Disposal of the agents and munitions at each of the eight existing storage sites.

2. Collocation and disposal of the munitions at two regional sites.

3. Collocation and disposal of the munitions at a single national site.

These three disposal alternatives were also described in a Draft Progammatic Environmental Impact Statement published by the Army in

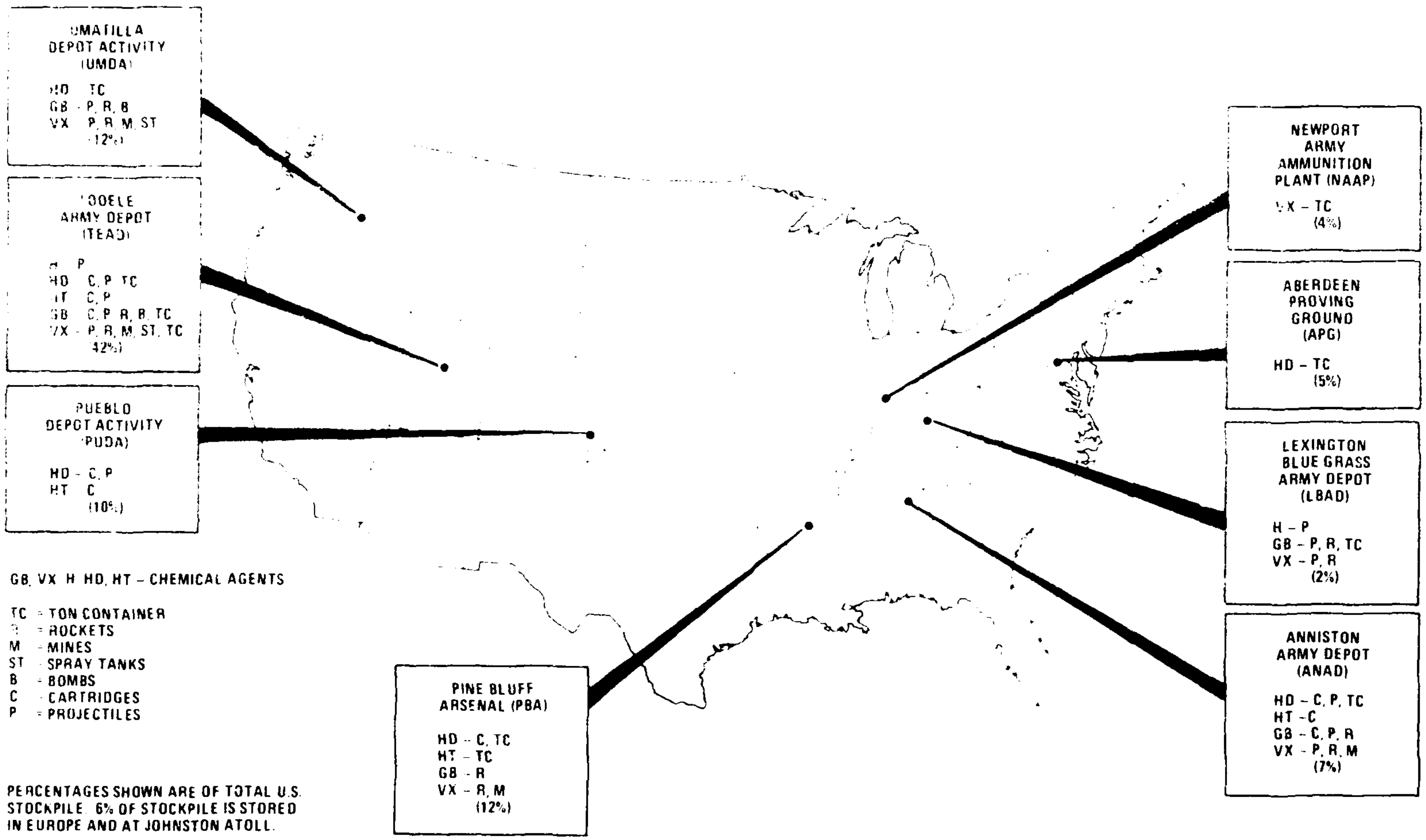


Fig. 1-1. Location of chemical agents and munitions in the U.S.

July 1986. Additionally, it was required that the status quo, i.e., continued storage, be also evaluated as the fourth alternative. As part of the public commentary on this document, requests were made of the Army to consider also the transport of the inventory from Aberdeen Proving Ground to Johnston Island by water or to Tooele Army Depot by air and from the Lexington-Blue Grass Army Depot to Tooele by air. These alternative options for offsite transport were also investigated during the study reported here. They represent subset options for the collocation option.

Under direction from the U.S. Army Office of the Program Executive Officer Program Manager for Chemical Demilitarization (PEO-PM Cml Demil), GA Technologies Inc. (GA) and its subcontractors have performed a comprehensive probabilistic assessment of the frequency and magnitude of agent release associated with activities involving the three disposal alternatives currently set forth in the Chemical Stockpile Disposal Program (CSDP), as well as the continued storage alternative. This assessment has been carried out in support of the environmental impact statement (EIS) for this program and it addresses only the stockpile of chemical munitions which are currently stored at the eight sites located in the continental United States (CONUS).

When combined with an assessment of the consequences (injuries and/or deaths) to the public resulting from the accident sequences and associated agent releases identified and evaluated in this study, the results form a basis for an assessment of public risk. The dispersion of the agent to the environment and the assessment of consequences related to these releases are outside the scope of this study. A consequence assessment has been performed by MITRE Corporation and Oak Ridge National Laboratory for the EIS, based on the releases identified in this document.

This report addresses the collocation alternatives identified above. The remaining alternatives are discussed in separate reports.

Anniston Army Depot (ANAD) in northeast Alabama and Tooele Army Depot (TEAD) in north central Utah have been identified as the regional sites, assuming this collocation alternative is selected. Should the single national site collocation alternative be selected, that facility would be at TEAD.

Previous studies have been utilized by GA as reference bases for this assessment. Quantitative hazards analyses were performed by Arthur D. Little, Inc. on the disposal of M55 rockets (Refs. 1-1 to 1-5), and qualitative hazards analyses were performed by the Ralph M. Parsons Company on the Johnston Atoll Chemical Agent Disposal System (JACADS) design (Refs. 1-6 and 1-7). In addition, a probabilistic analysis of chemical agent release during transport of M55 rockets has been performed by H&R Technical Associates (Ref. 1-8), and a probabilistic analysis of selected hazards during the disposal of M55 rockets has been performed by Science Applications International Corporation (Ref. 1-9). These studies provided the set of accident scenarios that was compiled in a systematic order by MITRE Corporation (Refs. 1-10 and 1-11). GA, in turn, used these accident scenarios as a starting point in this study.

The analyses performed by Arthur D. Little, Inc. used a technique known as hazard and operability analysis (HAZOP). HAZOP involves a detailed review of plant design to trace all parts and functions of the demilitarization process. For each piece of equipment or pipe run, deviations from normal operating conditions were examined and possible consequences were discussed. Through this approach, potential failure modes leading to agent release outside of the facility were identified. The expected frequencies of occurrence of all agent release sequences identified in the HAZOP were then evaluated using fault tree analysis.

The qualitative hazards analysis performed for JACADS used an approach known as failure modes and effects analysis (FMEA). The severity and probability levels of identified hazards were ranked according to the guidelines in Ref. 1-12.

The transportation studies performed by H&R Technical Associates (Ref. 1-8) used a combined fault tree and event tree approach to assess the frequency of agent release from transportation accidents.

The work performed by Science Applications International Corporation (Ref. 1-9) on the disposal of M55 rockets utilized both event tree and fault tree methodology as used in the PRA of nuclear power plants.

Demilitarization of the chemical munitions stockpile requires the construction of facilities to destroy the contents of the munitions, the handling, transportation, and storage of munitions at both the "sending" and the "receiving" site(s), the transport of munitions between sites, the destruction of the munitions, and the decommissioning of the constructed facilities. This report addresses each of these activities, except for facility construction and decommissioning.

1.2. STUDY OBJECTIVES AND SCOPE

The primary objectives of the study reported in this document were to:

1. Identify events (for each major activity) that could initiate the release of agent to the environment.

2. Develop the various sequences of events resulting from these initiators and leading to agent release.

3. Perform a quantitative analysis of the frequency of occurrence of each relevant accident sequence.

4. Characterize the form, quantity, and duration of agent release from each accident sequence.

5. Identify accident sequences which make the most significant contributions to risk.

The major deliverables of this effort are a list of potential accident sequences for each major activity, the estimated frequencies of these sequences, and the magnitudes of released agent associated with these sequences. It should be noted that only accident sequences that survived a conservative screening process, involving both frequency and magnitude of agent release, are included in these deliverables.

This report addresses each of the objectives listed above and presents the analysis of this study. The risk analysis includes an evaluation of potential accidents and natural occurring phenomena such as earthquakes and tornadoes. Acts of war, sabotage, and terrorism, which involve intentionally-initiated events, were not included in the scope of this effort.

The term "chemical munitions" is used here to describe both burstered chemical munitions and chemical bulk items. The 4.2-in. mortars refer to the actual 4.2-in. projectile which is fired from mortar cannons or tubes. The 105-mm cartridge and 4.2-in. mortar projectile can either be configured with propellant (i.e., a cartridge) or without propellant (i.e., a projectile); in this study, it was assumed that the propellant and fuze were removed prior to the onset of the disposal program.

1.3. DEMILITARIZATION ACTIVITIES AND SAFETY CONCERNS

Figure 1-2 shows a comparison of the various logistics phases associated with the various munition disposal and storage alternatives evaluated for the EIS. As indicated in this figure, the demilitarization process associated with the two collocation alternatives can be divided into five general areas of activity: storage, plant operations, handling, onsite transport and offsite transport. Except for the offsite transport activity, the onsite disposal alternative involves the same logistic phases. In contrast, only the storage activity is of concern for the continued storage option.

For each of these activities or phases, the hazards of interest are those involving the evaporative release of agent to the environment resulting from spills, leaks, and mechanical failures, and the release of agent to the environment resulting from fires and explosions. The generation of these potential hazards originates with a number of "internal" and "external" initiating events. The number of hazard-initiating event combinations is rather extensive. However, because of the screening process which was used to remove from further consideration the accident sequences whose frequency was low and/or the associated magnitude of agent release was low, the number of individual sequences which are important to risk is relatively small.

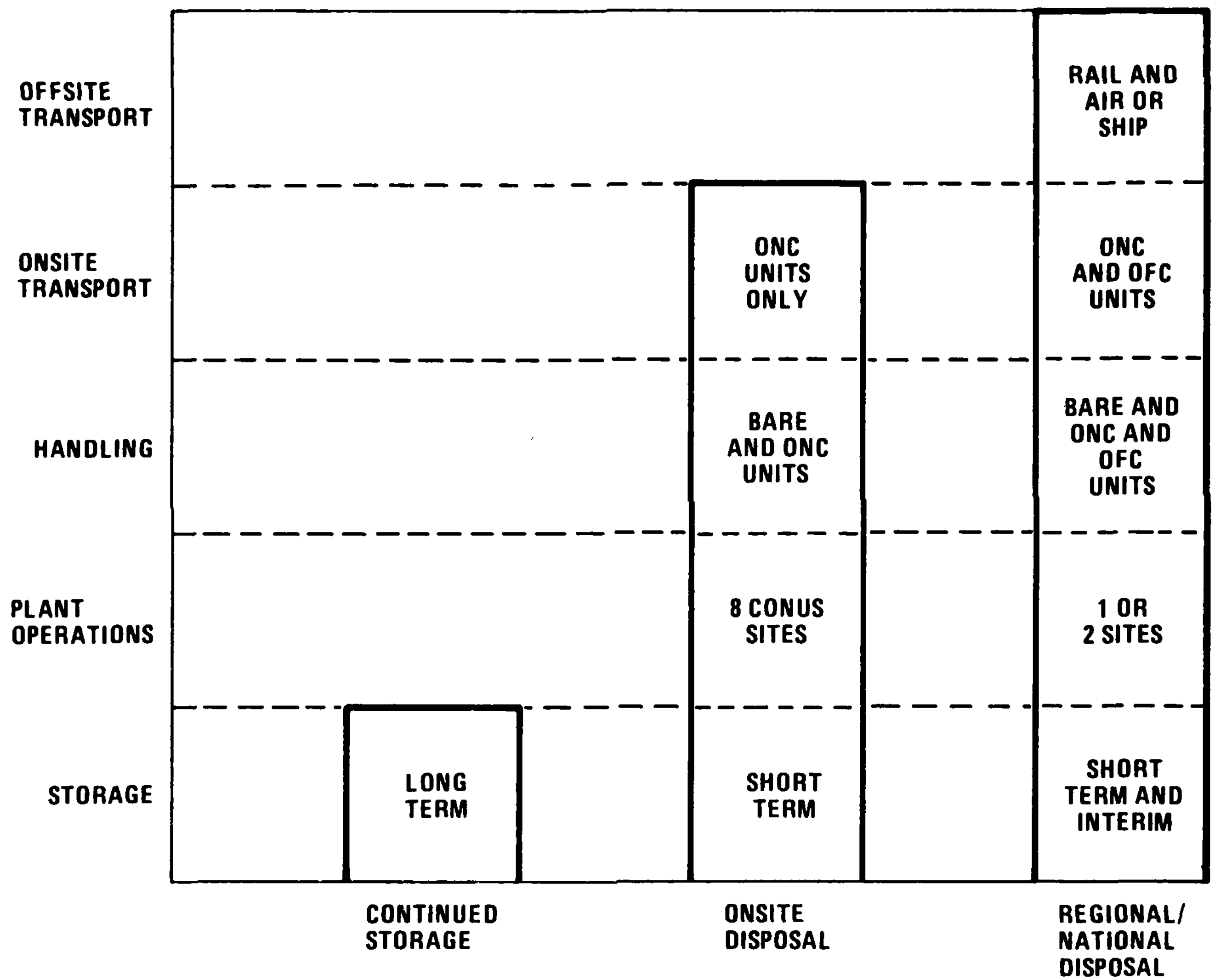


Fig. 1-2. Logistic phases associated with the munitions storage and disposal options

1.4. STUDY ASSUMPTIONS

The risk analysis presented in this report uses an approach that combines the structured safety analysis detailed in MIL-STD-882B (Ref. 1-12) and the probabilistic approach used in the safety analyses of nuclear power plants (Ref. 1-13). Reference 1-12 requires that hazards analyses be performed in order to assess the risk involved during the planned life expectancy of a system. It also provides some guidance on the categorization of hazard severity and probability as a means of identifying which hazards should be eliminated or reduced to a level acceptable to the managing activity.

The risk analysis was performed under the following set of general assumptions:

1. Onsite transportation of munitions will be by truck. The baseline offsite transportation mode analyzed was rail. Several specific offsite transport options by air or marine craft for selected stockpiles were also analyzed.

2. Munitions will be stored in their current storage locations and will be transferred to the demilitarization site as needed.

3. The baseline process design will be used (i.e., JACADS type facility). At TEAD, some existing process equipment will be used. Both of the collocation alternatives include a bulk-only facility, as well as a mixed munition plant design similar to the JACADS design. The design of the CONUS demilitarization facilities is now approximately 35% complete.

4. Munitions are in good condition during the handling, transportation, and disposal activities.

5. Sabotage or terrorism is not considered.

A detailed listing and discussion of assumptions is presented in Appendix E.

1.5. REPORT FORMAT

This report is structured as outlined schematically in Fig. 1-3. The structure follows that typically used in comprehensive probabilistic risk assessment (PRA) studies.

Following the introduction in Section 1 of this report, Section 2 provides a summary of the methodology used in this assessment, including the procedure for accident scenario identification and screening, the approach used for quantifying accident frequencies and characterizing agent release, and the treatment of uncertainties.

Section 3 provides a brief discussion of the various activities involved in the disposal of chemical munitions. This discussion is provided to assist readers in the understanding of the initiating events and accident scenarios that have been identified and are discussed in Sections 4 through 8. This section also discusses site-specific information that is important to a particular site. Appendix D contains additional site information.

The list of accident initiating events which have been analyzed is along with the analysis of their occurrence frequencies are presented in Section 4. These events include accidents from internal causes, such as inadvertent impact during handling, and accidents caused by external events, such as earthquakes or aircraft crashes.

Sections 5 through 8 present the detailed development and analysis of the key accident scenarios resulting from the initiating events.

Section 9 provides the basis for quantification of accident sequence frequencies including munition failure probabilities, the data base used for estimating the probabilities of event-tree top events and fault-tree basic events, and the data used for assessing human error.

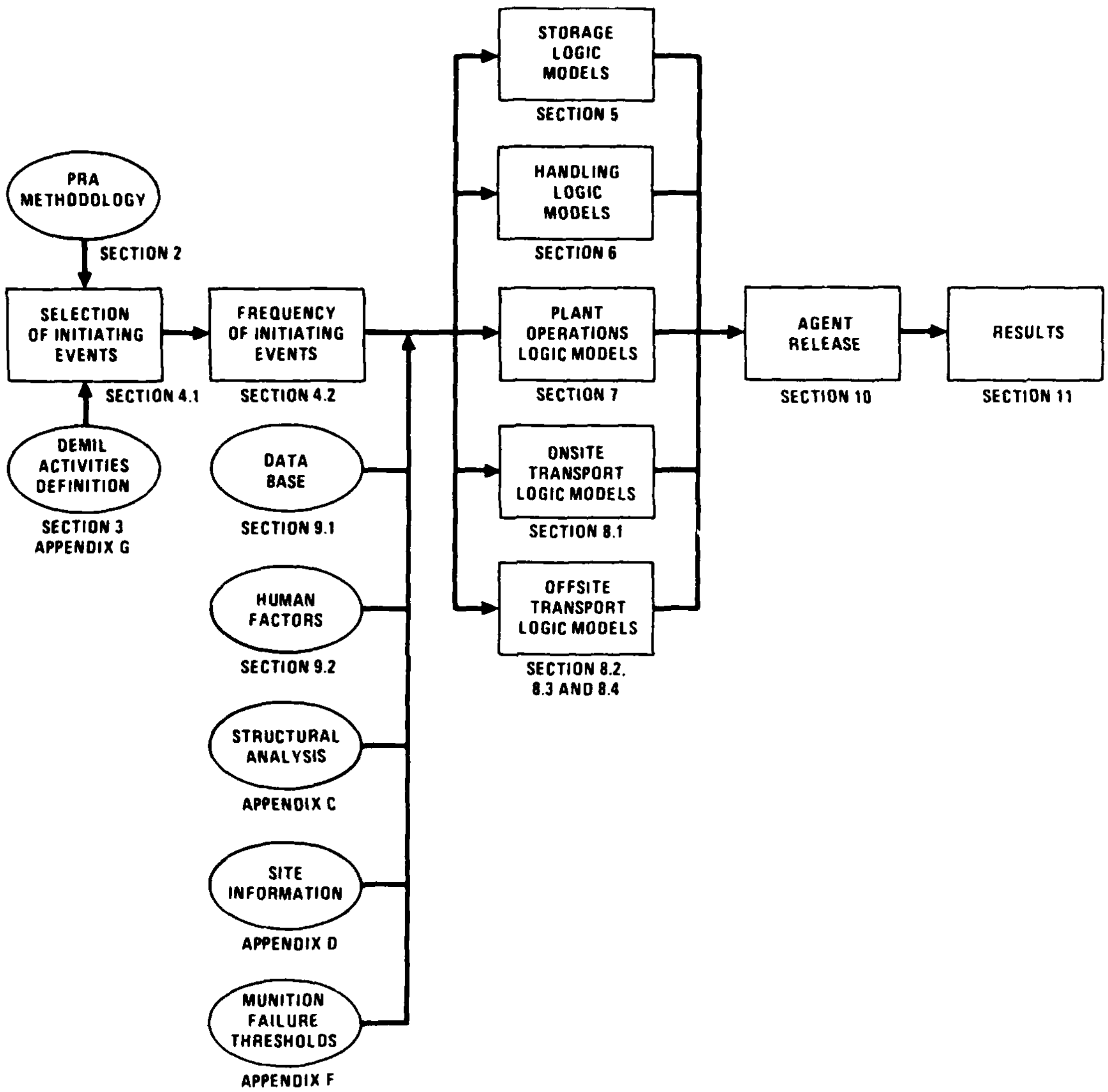


Fig. 1-3. Outline of report structure

The characterization of agent released in the various accident sequences is discussed in Section 10.

Section 11 presents the overall results of the analysis. The results presented in Sections 4 through 8 are summarized for both col-location alternatives to highlight the accident sequences which are predicted to have the highest frequencies of occurrence or large agent releases.

Supporting data and calculations for the study are contained in the appendices. References to appropriate appendices are made throughout the body of the report.

1.6. REFERENCES

1-1. Arthur D. Little, Inc., "Analysis of Risks Associated with Operation of Onsite M55 Rocket Demilitarization Plants," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-3, May 1985.

1-2. Arthur D. Little, Inc., "Analysis of Risks Associated with Operation of the JACADS M55 Rocket Demilitarization Plant," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-9, May 1985.

1-3. Arthur D. Little, Inc., "Analysis of Converted M55 Rocket Demilitarization Plant at Pine Bluff Arsenal," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-10, May 1985.

1-4. Arthur D. Little, Inc., "Analysis of Risks Associated with Operation of the CAMDS M55 Rocket Demilitarization Plant," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-11, May 1985.

1-5. Arthur D. Little, Inc., "M55 Rocket Separation Study," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-08, November 1985.

1-6. The Ralph M. Parsons Company, "JACADS-Preliminary Hazards Analysis of Final Concept Design," Task G-56 Interim Report, May 1983.

1-7. The Ralph M. Parsons Company, "Fault Tree Analysis, Johnson Atoll Chemical Agent Disposal System," Task G-SC, U.S. Army Engineers Division, February 1985.

1-8. Rhyne, W. R., et al., "Probabilistic Analysis of Chemical Agent Release During Transport of M55 Rockets," H&R Technical Associates, Inc., Prepared for USATHAMA, M55-CD-4, H&R 255-1, September 1985.

1-9. Science Applications International Corporation, "Probabilities of Selected Hazards in Disposition of M55 Rockets," U.S. Army Toxic and Hazardous Materials Agency, M55-CS-2, November 1985.

1-10. Fraize, W., et al., "Preliminary Risk Analysis Supporting the Chemical Stockpile Disposal Program (CSDP), Volume 1: Analysis," MTR-86W4-01, the MITRE Corporation, May 1987.

1-11. Fraize, W., et al., "Preliminary Risk Analysis Supporting the Chemical Stockpile Disposal Program (CSDP), Volume 2: Appendices," MTR-86W4-02, the MITRE Corporation, May 1987.

1-12. U.S. Department of Defense, "Military Standard System Safety Program Requirements," MIL-STD-882B, March 30, 1984.

1-13. U.S. Nuclear Regulatory Commission, "PRA Procedure Guide," NUREG/CR-2300, 1982.

2. RISK ASSESSMENT METHODOLOGY

2.1. OVERVIEW

The probabilistic risk assessment (PRA) methodology used in this study is generally consistent with the PRA Procedures Guide (Ref. 2-1) for nuclear power plants. Figure 2-1, adapted from that guide, outlines the risk assessment procedure for this study. Certain specific features of the demilitarization process dictate some different emphasis and treatments from those described in Ref. 2-1. The risk assessment steps corresponding to the procedures in Fig. 2-1 are as follows:

1. Identify accident initiators (initiating events) through information collection, hazards analyses, or the use of master logic diagrams. The initiating events are classified as external if they originate from outside the demilitarization process (such as aircraft crash) and as internal otherwise.

2. Define accident scenarios, i.e., combination of initiating events and the successes or failures of systems that respond to the initiating event. An "accident sequence" is referred to in this report as a specific end point of an accident scenario, which is usually modeled using event trees. An "event tree" is an inductive logic model which traces the sequence of events that can occur following an initiating event.

3. Construct "fault trees" (deductive system logic models) to determine the root causes of individual system failures. The fault tree is reduced to minimal cut sets using Boolean algebra. A "minimal cut set" represents a unique combination of events leading to system failure.

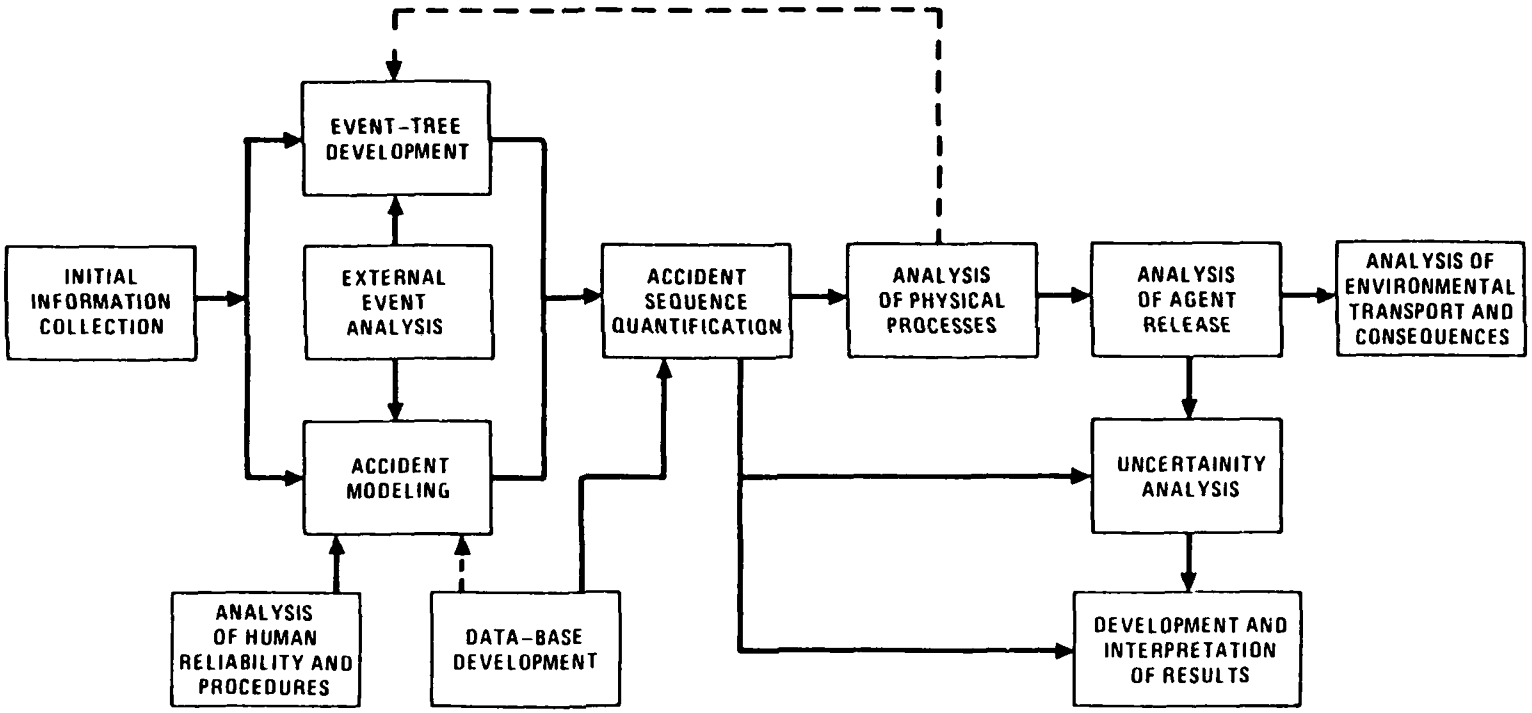


Fig. 2-1. Outline of risk assessment procedure used in this study

4. Assign failure rates or probabilities to events (components or subsystem) modeled in the event trees and fault trees. Quantify the frequencies of occurrence of accident sequences from either the event tree or fault tree by computing the product of the initiating event frequency and the probabilities of the subsequent conditional events in a given accident scenario.

5. Determine the consequences of the accident sequences. In this analysis, the consequence of concern is the amount of agent released to the local free environment. The impact of agent release on the population will be used by others in their CSDP analysis.

6. Evaluate the uncertainties in the data base, and predict the uncertainty in each relevant accident sequence frequency by propagating the top event uncertainties through the event trees.

7. Present the results (i.e., accident scenario frequency and consequence) in a form that will best show those scenarios that are important to risk and will reflect the uncertainties associated with the accident sequence frequency.

2.2. INITIATING EVENTS

An initiating event is a single occurrence or malfunction that has the potential to release one or more agents or to start a sequence of events that could lead to a release. The list of initiating events is developed based on previous demilitarization studies (Section 1.2) and related PRAs such as Waste Repository studies (e.g., Ref. 2-2), in addition to the use of master logic diagrams.

The initiating event list is developed in top-down fashion by structuring a master logic diagram to define a functional set of initiating categories. These categories form a complete set in the sense that any event which leads to agent release must cause at least one of these categories to occur.

Some "common cause initiating events" (e.g., an earthquake) can activate more than one initiating event category and disable controls for release. While there is no way to guarantee that all such events are identified, two areas yield the most significant events. The first includes severe environmental events (such as fire, flood, earthquake, and wind) as well as hazardous activities in the vicinity (such as aircraft patterns). The second area includes malfunctions that can affect multiple controls or barriers for the prevention of release to the atmosphere.

Coincident with the development of the list of initiating events is the assessment of the initiating event frequencies. This is required, first, for subsequent quantification of event trees, since the event initiator is the first event of the tree. Second, it enables screening of the list of initiating events, i.e., events having extremely low frequencies can be eliminated. Where possible, the initiating events are grouped into categories when the subsequent event tree and release analysis development is the same for all initiating events in the category. This grouping is performed by Boolean summation of the occurrence frequencies, accounting for dependencies, if any.

2.3. SCENARIO DEVELOPMENT AND LOGIC MODELS

Given the occurrence of an initiating event (IE), accident scenarios are developed, in many cases using logic models of either event trees, fault trees, or both, to arrive at the various outcomes of the scenario progression. Each of these outcomes, termed a sequence, is associated with (or even characterized by) a certain level of agent release. The basic premise of the risk summation process is that release frequencies (initiating event frequency multiplicatively combined with probabilities of subsequent failures necessary to get the release) of entirely different sequences can be additively combined to get the overall frequency of release. The additive and multiplicative combination is performed using Boolean algebra and accounts for dependencies.

Figure 2-2 shows a sample event tree. In this example, the IE is a vehicle collision, having an estimated occurrence frequency which can be a point estimate or be probabilistically distributed. The IE is the first "top event," and potential subsequent failures represent the other top events or branch points. These top events are in the form of questions, and by convention the upper branch represents the positive answer sequence and the lower branch is the negative answer sequence. Branch split fractions or probabilities are assigned at each of these branch points. These split fractions may be point estimates or probabilistic distributions, and may not be the same for all branch points under a specific top event, depending on prior events. That is, the split fractions represent conditional probabilities.

The frequency of an accident sequence is calculated based on the following equation:

$$F_j = I_j \prod_{i=1}^{n} P_{i,j} \quad , \tag{2-1}$$

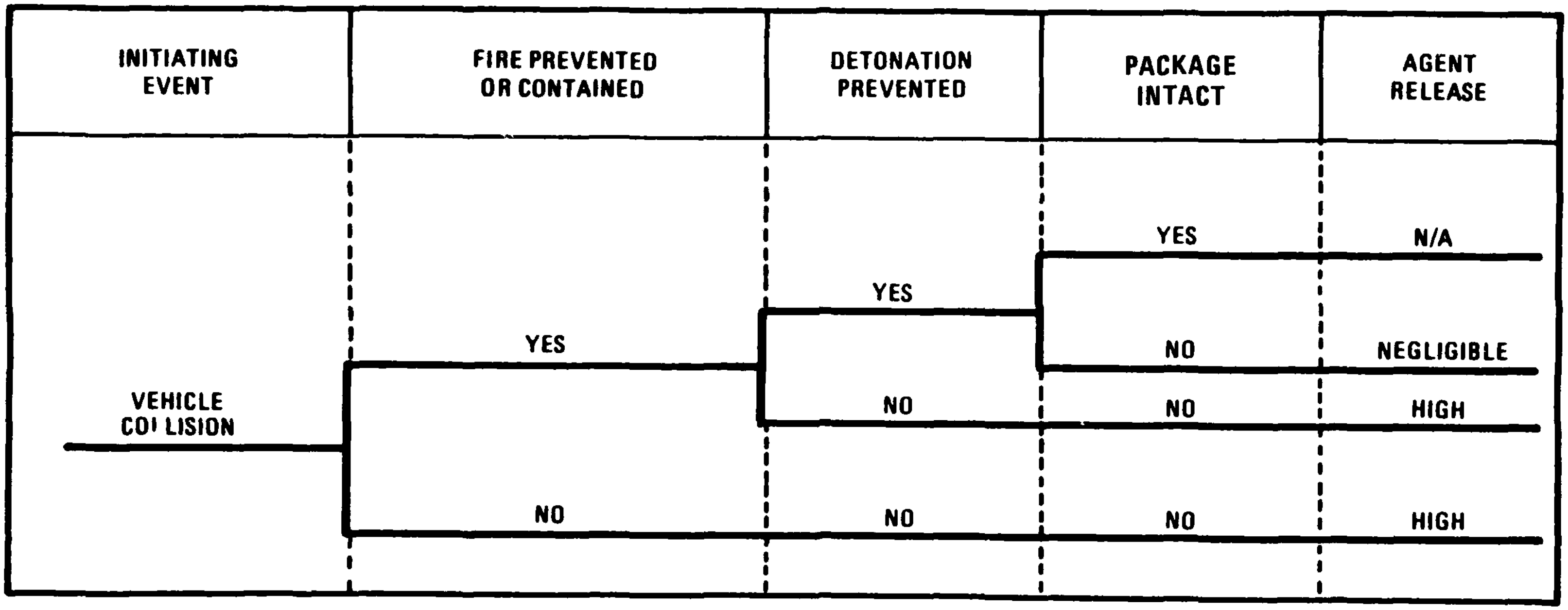


Fig. 2-2. Accident scenario development using an event tree

where F_j = frequency of accident sequence j,

I_j = initiating event frequency,

$P_{i,j}$ = conditional probability of event sequence i following an initiating event, I_j.

Accident frequency and equipment/component failure rate data were derived from various sources, as described in Section 9.

In this study, the event trees are relatively simple in form compared to those developed for nuclear plant PRAs. Most dependencies are modeled explicitly in the event trees by use of conditional branching probabilities which are dependent upon the branch taken for prior events. For example, in an event tree where two consecutive top events represent the availabilities of systems 1 and 2, system 2 might not be called upon unless system 1 fails. This would be shown in the event tree by a dashed line for system 2 in the system 1 success branch, indicating not applicable. Conversely, if system 2 is capable of operating only in conjunction with successful operation of system 1, the dashed line is shown on the system 1 failure (no) branch for system 2 top event. This indicates a guaranteed failure of system 2, given nonoperation of system 1.

For many scenarios, it was found convenient to use fault tree logic for development of the accident progression and quantification of the sequence frequencies. Figure 2-3 depicts a sample fault tree. Logic symbols used in constructing fault trees are defined in Fig. 2-4. The approach taken for treatment of dependencies in the event trees is to identify specific intercomponent and intersystem causes of multiple failures, if any, directly in the fault tree and to make an allowance for those not explicitly identified. A Beta factor method (e.g., Ref. 2-3) is a convenient tool for determining a suitable allowance and was used where appropriate. In this method, multiple failures of redundant components are assumed to occur in a dependent fashion; the

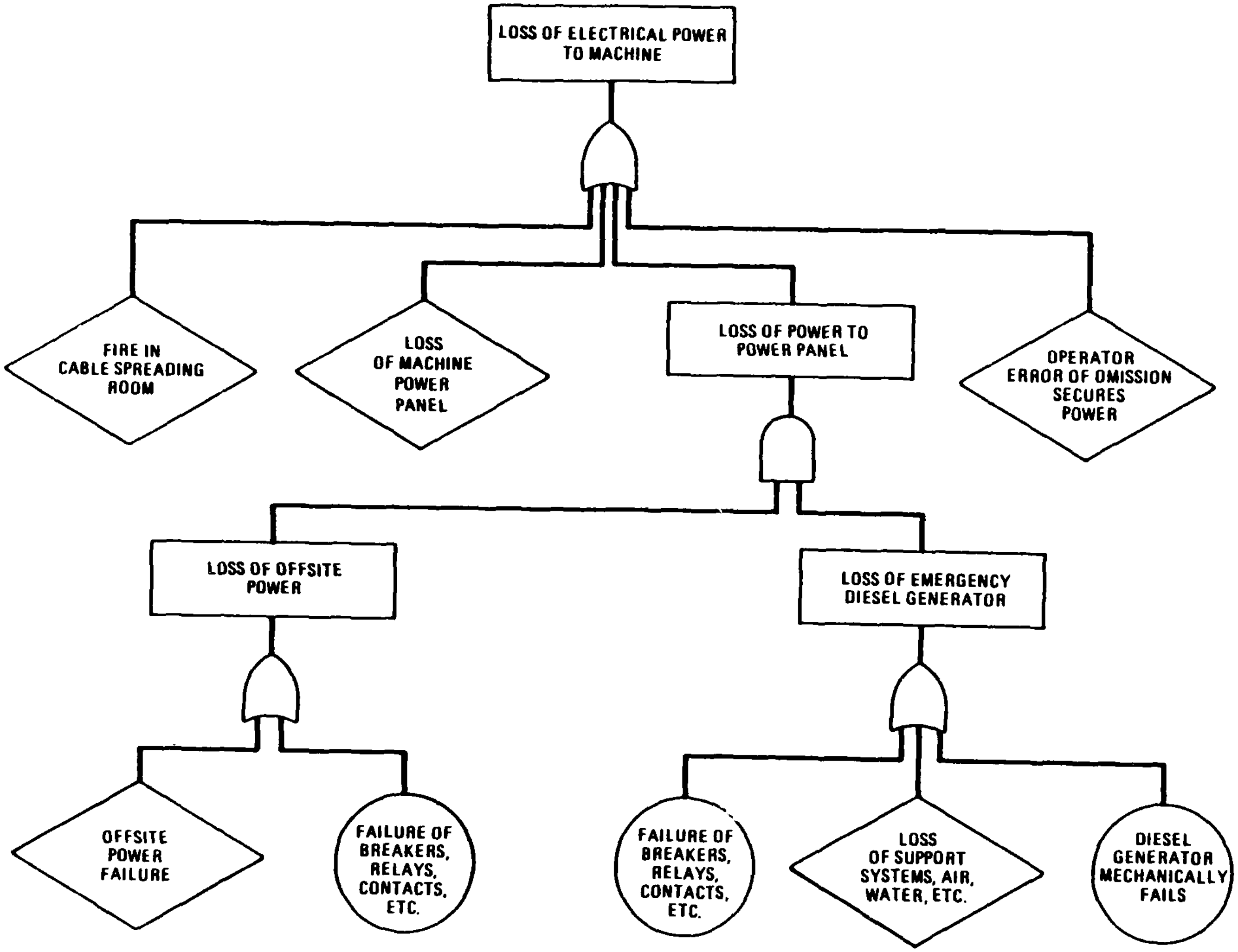


Fig. 2-3. A fault tree model of a power system failure

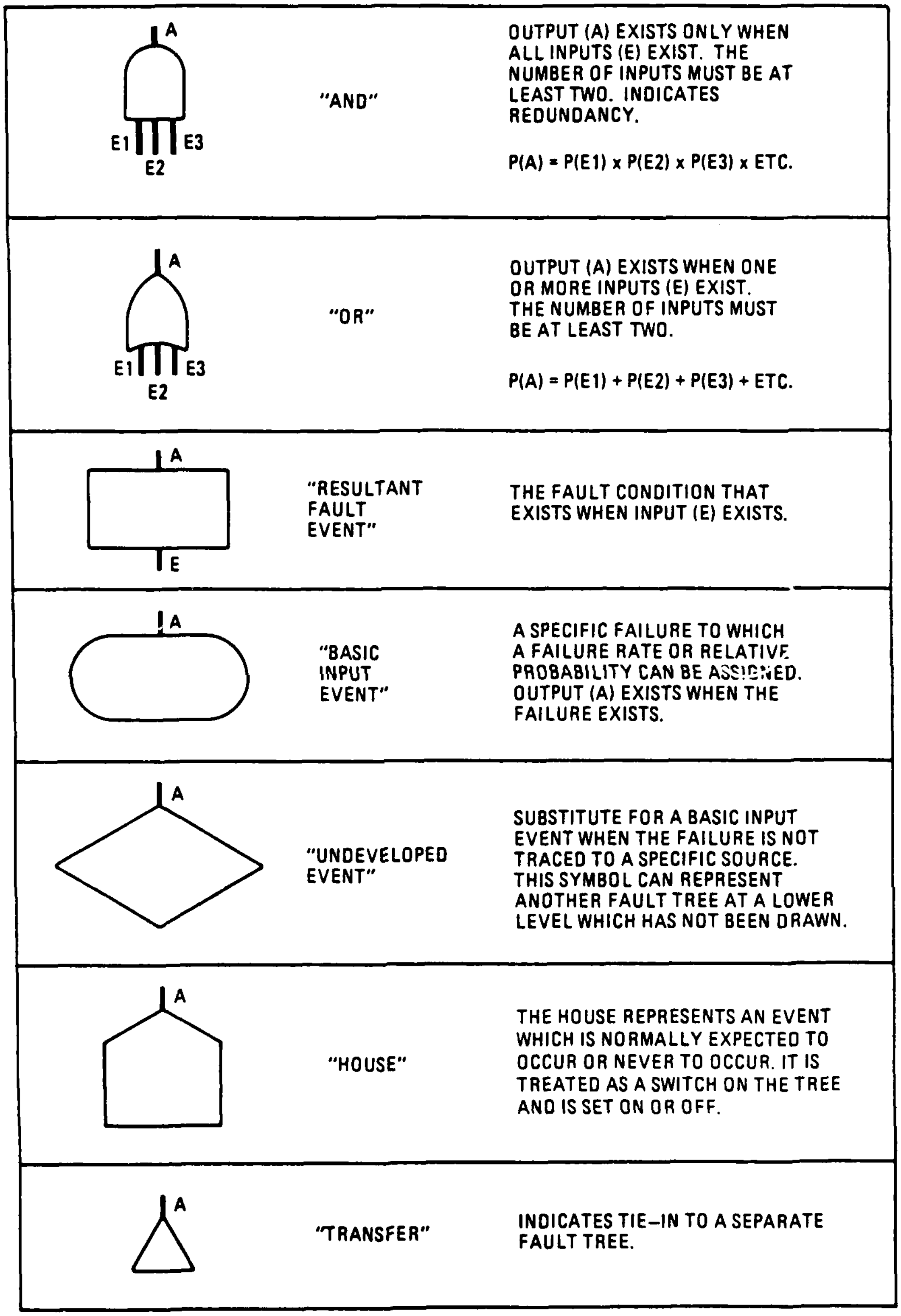


Fig. 2-4. Definition of fault tree symbols

parameter β is defined as the fraction of failures experienced in components that are common cause failures.

Just as there are uncertainties in estimating component failure rates, there are also uncertainties in the β factor. These uncertainties were quantified assuming lognormal distribution for the β factor. The uncertainty distribution accounts for uncertainties due to sparsity of data, as well as those due to classification and the so-called "potential common cause failures." These are events in which one failure actually occurs and additional failures could have occurred under different circumstances, as well as incipient failures and degraded operability states.

In the case where the fault sequence i, given an initiating event, involves a subsystem or equipment failure, the failure probability calculations may involve not only the calculation of the unavailability value (probability of failure per demand) but also the unreliability value (probability of failure while component/equipment is running). In this case, the overall failure probability value for a given equipment or subsystem is calculated using the following equation (Ref. 2-3):

$$P_i = P_{i,d} + (1 - P_{i,d})\, P_{i,r} \quad , \qquad (2\text{-}2)$$

where $P_{i,d}$ = failure upon demand (unavailability),
$P_{i,r}$ = failure while running (unreliability).

The calculation of component unreliability ($P_{i,r}$) is influenced by several factors: (1) the frequency of periodic maintenance (PM); (2) the use of different failure detection systems; and (3) the various methods used to monitor equipment operation.

For the analysis presented in this report, two options were considered in the calculation of component unreliability. The first option was to consider the periodic maintenance of a component. Thus, when a

component is periodically removed from service for preventative maintenance, the failure probability is dominated by the maintenance interval in addition to the failure rate according to the following equation:

$$P_{i,r} = \frac{1}{\lambda\theta}\,(1 - e^{-\lambda\theta}) \approx \frac{\lambda\theta}{2} \quad , \tag{2-3}$$

where λ = failure rate,

θ = maintenance interval.

The second option was to consider continuous component surveillance which decreases the failure probability by announcing component failure to the operators concurrent with failure initiation. The repair time required to restore the component becomes an important factor as shown in the following equation:

$$P_{i,r} = \frac{\lambda}{\lambda + \nu}\,[1 - e^{-(\lambda+\nu)t}] \quad , \tag{2-4}$$

where $\nu = 1/\tau$ mean repair rate (per h),

τ = repair time (h),

t = time interval of interest.

In Eq. 2-5 the failure probability approaches $\lambda\tau$ as the time interval increases and $\lambda\tau$ is small (i.e., $\lambda\tau \ll 1$).

In most of the component failures identified in the fault tree models, the first option is used (i.e., calculating reliability as a function of maintenance interval) and a monthly PM interval is assumed (i.e., maintenance interval of 528 h) for the equipment. This is a conservative approach in deriving the failure probability. If a more frequent maintenance policy is adopted or if experience shows that the component restoration time is much less than the maintenance interval, the failure probability will decrease. However, in view of the nature of the fault tree models, this approach seems justified because the

failure contribution of a particular component is not negated by assuming an unnecessarily low failure probability.

2.4. HUMAN FACTORS

The treatment of intersystem and intercomponent equipment dependencies is discussed above, including how dependencies are taken into account by the logic models. This section describes another kind of dependence--that involving human interaction.

To the extent that human beings design, construct, operate, and maintain the plant, it is impossible to fully isolate the role of human interactions from any of the dependencies discussed above in terms of hardware interactions. Hence, all of the common cause analysis methods described above pertain directly or indirectly to human interactions. The discussion is restricted here to human intervention in the operation and maintenance processes.

The procedure used for analysis of intersystem and intercomponent dependencies caused by human interactions was to include human errors of omission and commission explicitly in the event tree/fault tree models and to use the human reliability methods of Swain (Ref. 2-4) to implement quantification. A starting point for the identification of specific errors is the analysis of operation and maintenance procedures if they have been defined for the event sequence being investigated. This is especially important if operator action is required to effect actuation of a system or a collection of systems. Consideration needs to be given to possible incorrect judgments as to the plant state and subsequent implementation of the wrong procedures. Once these acts are identified and modeled, the problem of determining contribution to risk by operator actions is reduced to assigning the correct human error rate values.

2.5. RELEASE CHARACTERIZATION

The risk associated with each accident scenario requires not only the quantification of the frequency of that scenario but a characterization of the agent release as well. This characterization involves the type and amount of agent released, and the mode duration of the release.

At any given time, there is at least one containment barrier separating the agent from the surrounding environment. Thus failure or loss of integrity of this barrier must occur for agent to be released to the environment.

In general, the accident scenarios interest can be divided into two groups: (1) those scenarios in which the agent is inside the munition (e.g., scenarios involving transportation accidents), and (2) those in which the agent has been removed from the munition (plant operations accident scenarios). For both of these groups there are essentially three types of agent release to the environment:

1. Evaporation from a liquid spill.
2. Releases resulting from detonations.
3. Releases resulting from fires.

Various combinations of these releases appear in many of the scenarios. In addition, depending on the location of these events (e.g., indoor versus outdoor spills), the evaporation rates governing these releases may vary somewhat.

The approach taken for assessing the amount, type, and duration of agent release is based on deterministic models which stem from previous demilitarization safety studies described in Section 1.1. These models are based largely on data but also engineering judgment. They are described in Section 10.1.

Elements of the model include correlations for evaporation release, based on the D2PC computer program. In many cases, the D2PC computer program was used directly to calculate evaporative releases. Other elements include the fraction of burning agent which is released as vapor and the fraction of a detonating munition inventory which is released as vapor. The model relies heavily on data and analysis of munitions failure thresholds, summarized in Appendix F, to determine the extent of munition failures, including the potential for failure propagation of munitions. It is this area where engineering judgment was needed to supplement the data and analysis. Where judgmental factors entered in, they were routinely made in a conservative manner to cover possible uncertainties.

2.6. UNCERTAINTY ANALYSIS

Estimates of failure probabilities derived from various data sources are subject to uncertainties. Data sources do not always specify what failure modes are represented, what environment is applicable, or what is the total statistical population. In some cases, failure data may not be available for a specific event; therefore, data for events that occur under conditions that are similar to the events under consideration are selected as representative. These considerations result in uncertainties that are reflected in the range of possible numerical values for an event.

For events involving equipment failures, a lognormal distribution was assured to define the uncertainty in the failure probability. The lognormal distribution was explicitly used in Ref. 6-18 and other PRA studies of nuclear power plants because of its mathematical behavior. For the analysis covered in this report, equipment failures and accident initiators that are either man-made or arise from natural causes are assumed to be lognormally distributed.

In the analysis of accident scenario probabilities, the STADIC-2 computer program (Ref. 2-5) was used to combine probability distributions of a series of event sequences which make up an accident scenario. STADIC-2 uses a Monte Carlo simulation technique to generate a pseudo-random sample statistical distribution for a user-defined output function. Each input variable exhibits random, statistical variations that are represented by a particular probability distribution (lognormal, normal, etc.). The statistical distribution for the output function (and accident scenario probability in this case) is generated by combining the distributions in accordance with the mathematical operations

specified by that function. This combining of distributions is accomplished as follows:

1. Each Monte Carlo sample consists of selecting one pseudo-random sample value for each input variable from its corresponding statistical distribution.

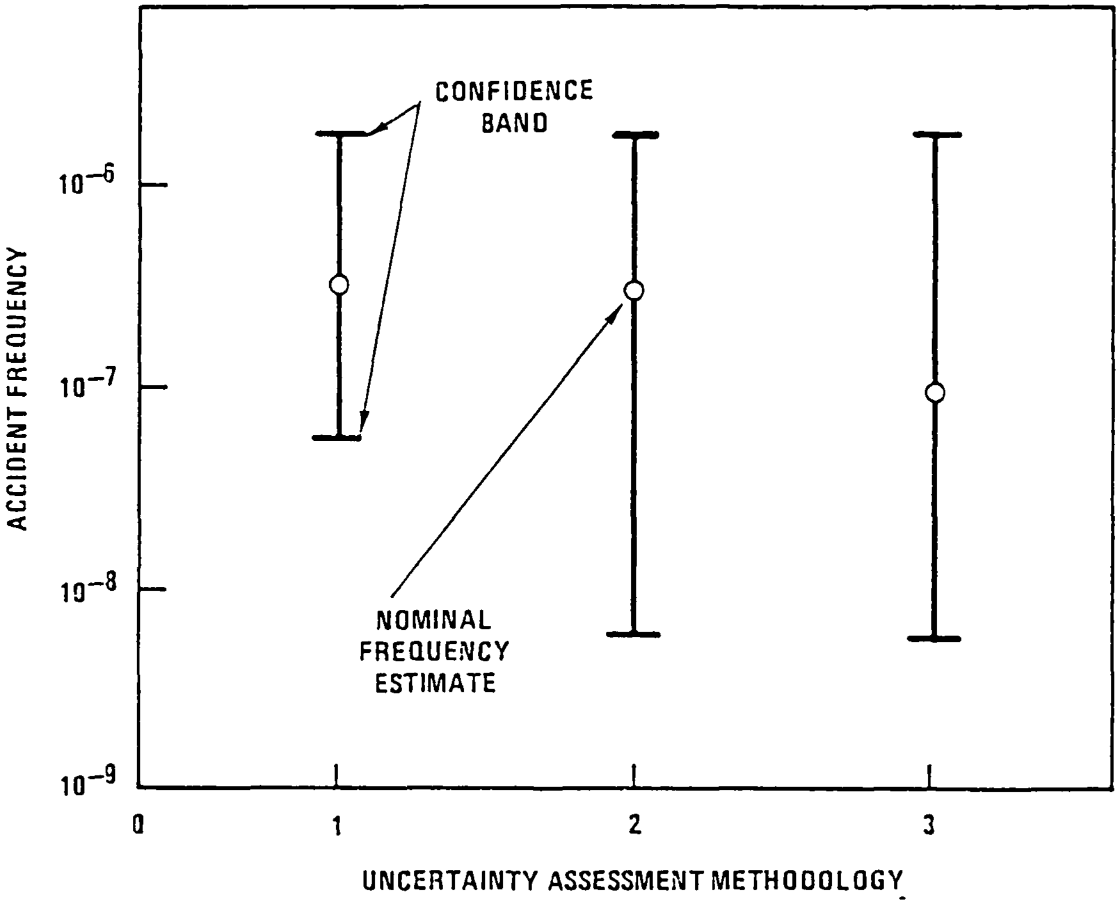
2. The set of sample variable values are mathematically combined to find the corresponding value of the function.

3. Sampling is continued in this manner until the desired sample size is attained.

4. The results consist of the pseudo-randomly generated values of the output function.

Probabilistic data base uncertainties are the only uncertainties explicitly quantified in this analysis. Although data base uncertainties are important, the accident frequency calculations are also sensitive to assumptions incorporated into the probabilistic assessment. Since the uncertainties in these assumptions are extremely difficult to quantify, conservative assumptions are consistently used in this risk analysis.

Figure 2-5 depicts the impact of this methodology (identified as Method 1 in the figure) on the accident frequency assessment results. Essentially, this methodology produces a conservative nominal frequency estimate, and underestimates the size of the confidence bands. However, the error associated with the confidence band estimate primarily results in predicting a much higher value for the lower confidence band than actually exists. (Compare the results of Methods 1 and 3 in Fig. 2-5.) Hence, the uncertainty assessment methodology employed in this analysis overestimates nominal accident frequencies and the confidence in the predicted frequency.



METHOD	DESCRIPTION
1	CONSERVATIVE ASSUMPTIONS, ONLY DATA BASE UNCERTAINTIES QUANTIFIED
2	CONSERVATIVE ASSUMPTIONS, ALL UNCERTAINTIES QUANTIFIED
3	REALISTIC ASSUMPTIONS, ALL UNCERTAINTIES QUANTIFIED

Fig. 2-5. Impact of assumptions on the accident frequency uncertainty assessment

No quantitative uncertainty analysis is performed for the agent release calculations, due to the complexity involved in such an assessment. Instead, conservative releases are calculated. Because of the complex phenomenology that governs agent release, sensitivity studies were conducted to assure that the agent release estimates are, indeed, bounding. These sensitivity analyses are presented in Appendix B.

2.7. REFERENCES

2-1. U.S. Nuclear Regulatory Commission, "PRA Procedures Guide," NUREG/CR-2300, 1982.

2-2. GA Technologies Report for Sandia National Laboratories, "High-Level Waste Preclosure Systems Safety Analysis Phase II Progress Report," GA-C18557, August 1986.

2-3. Fleming, K. N., "A Reliability Model for Common Mode Failures in Redundant Safety Systems," Procedures of the Sixth Annual Pittsburgh Conference on Modeling and Simulation, April 1975.

2-4. Swain, A. D., and H. E. Guttmann, "Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications," NUREG/CR-1278, SAND 80-0200, August 1983.

2-5. Koch, P., and H. St. John, "STADIC-2, A Computer Program for Combining Probability Distribution," GA Report GA-A16777, July 1983.

3. DEMILITARIZATION DESCRIPTION OVERVIEW

Chemical munitions are currently stored at eight CONUS sites (Fig. 1-1). A description of the CONUS sites, including local maps, is given in Appendix D. Section 3.2 provides a summary description of the munitions.

The two alternatives for the disposal of the chemical munition stockpile which are discussed in this report are: (1) collocating munitions for disposal at two regional destruction centers (RDCs) located at the Tooele Army Depot (TEAD) in Utah and Anniston Army Depot (ANAD) in Alabama; and (2) collocating munitions for disposal at a single national destruction center (NDC) located at TEAD. A detailed discussion of the storage, handling, operations, transport, and decommissioning activities related to the alternatives is presented in Appendix G. Section 3.1 provides a summary of these activities as they relate to the risk study. Data for the munition transport containers are presented in Section 3.3.

3.1. COLLOCATION DISPOSAL ACTIVITIES AND RISKS

The major activities for the two collocation alternatives are outlined in Fig. 3-1. The activities begin with the munitions at each CONUS site in their existing storage locations in magazine igloos, warehouses or open areas. Long-term risks associated with continued storage, such as earthquakes and munition maintenance, are reduced by shipment to NDC or RDC disposal sites. This risk reduction must be weighed against risks associated with the transfer and disposal of the munitions. Elements of the added risks are: added storage risks created by establishing holding areas and interim storage, handling, plant operations, onsite transport, and offsite transport risks. These are discussed in the following paragraphs.

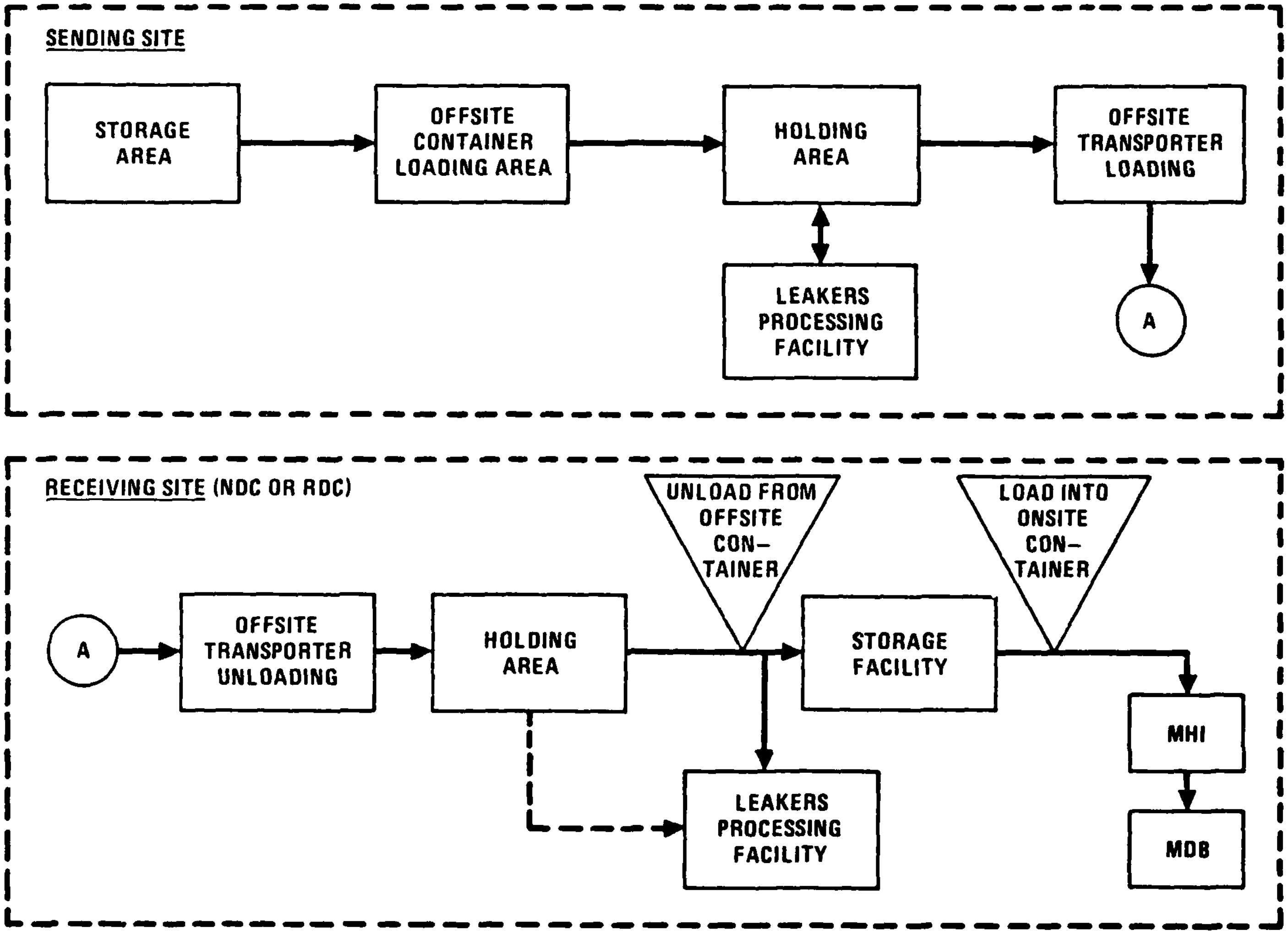


Fig. 3-1. Activities associated with munitions handling and transport

3.1.1. Storage

During storage, the only planned activities are monitoring for leakage, surveillance, maintenance and repair of munitions in the stockpile. Internal events for storage thus address leakage between inspections and munition drop or forklift tine puncture during munition handling. The stored munitions are susceptible to external events, such as fire, tornado, aircraft or meteorite crash, earthquake, flood, and lightning. Storage time is a critical parameter for both the internal and external events. Until the sending site agent inventory is depleted, the holding areas established at both the sending and receiving sites create additional locations where munitions will be present with added interface area with potential external events.

In this study, the munitions are assumed to spend two weeks at each holding area. The munitions are moved from the holding areas to interim storage facilities. They stay considerably longer in interim storage; for purposes of analysis it is conservatively assumed that the interim storage facilities are full.

3.1.2. Handling

The munitions transfer from existing CONUS sites to one or two disposal sites creates a multitude of logistic handling operations. These operations are identified in Fig. 3-1 for handling at the sending and receiving sites and for offsite transport by rail or air. A detailed diagram of the loading/unloading of munitions into/out of the transport packages and loading/unloading the packages off the trucks and onto the trains, etc., is presented in Section 6. The handling operations for the specific option of marine transport from APG to Johnston Atoll differ in that a different offsite package is used, ship crane and dock crane loading/unloading is involved.

Basically, the risks associated with these handling operations stem from internal handling accidents, caused by equipment failures or human error. Types of accidents are: vehicle collisions, forklift tine punctures, and drops of munitions. The munitions affected may be single, in pallets or overpacks (bombs and spray tanks), in an onsite container (ONC) or in an offsite container (OFC) or vault. Locations of the agent release may be indoors, or in the open (outdoors). External events causing handling accidents were not considered in this analysis because of the short time involved in actual outdoor handling operations. Also, the analyses for plant operations and storage considers the effect of external events on all munitions within buildings or igloos, regardless of whether or not handling is in progress.

The handling risk depends on the number of handling operations, such as packing, loading, and separating, moving or stacking with a forklift, which in turn depends upon the sites involved, the mode of offsite transport, and the type of munition moved. Section 6 describes how these variables were factored into the analysis.

Packing and unpacking handling operations occur first at the sending site storage area, where the munitions are packed inside an OFC. They remain inside that package until arrival at the interim storage area (igloo or warehouse) of the NDC or RDC. There, they are unpacked and stored in their original palletized configuration until ready for disposal. For disposal processing, they are packed in an ONC for shipment from interim storage until reaching the unpack area of the MDB. This procedure results in the munition always being in an ONC or OFC while outdoors onsite, and in the OFC when enroute offsite. Note: for marine transport, vaults will be used instead of OFCs; for the discussion in this section, the package will be referred to as an OFC.

The procedure assumed here of temporarily storing the munitions arriving at the NDC or RDC in a storage igloo or warehouse and subsequently moving them again (by truck) from storage to the munitions

holding igloo (MHI) has more handling operations than direct delivery to the MHI. Logistics may permit simple direct delivery; nonetheless, the complex logistics scheme is adopted for this risk analysis as a conservative approach. The MHI is a part of the demilitarization facility. The munitions are moved from the MHI to the package unloading area of the facility by forklift.

Loading and unloading handling operations occur at multiple times as follows:

1. At the sending site storage area, the OFCs are loaded into trucks for onsite transport to the holding area (e.g., railhead, for rail transport).

2. At the sending site holding area, the OFCs are unloaded from the truck and held until reloaded on the railcar for offsite transport by rail. For the air transport option, the OFCs are loaded onto a truck bound for the airport. At the airport the OFCs are off-loaded onto a conveyor which loads them into the aircraft. For marine transport, the vaults are trucked to the loading dock where they are loaded by crane into the barge.

3. At the receiving site, the rail shipments arrive directly at the NDC or RDC holding area, where the packages are off-loaded. Air shipments are transferred by conveyor from the aircraft to trucks for arrival and off-loading at the NDC or RDC holding area. Marine shipments are off-loaded by crane onto the dock.

4. At the holding area, the OFCs are loaded onto a truck for on-site transport to an interim storage area.

5. At the interim storage area, the palletized munitions are unloaded from the OFCs and placed in storage. The munitions

are then placed in ONCs and loaded onto trucks for onsite transport to the MHI.

6. At the MHI, the ONCs are unloaded from the trucks and placed in the MHI. For disposal, they are removed from the MHI by electric forklift and loaded onto diesel forklifts for transport to the MDB.

7. At the MDB, the forklifts deposit the ONCs in the Package Unloading Area for final processing.

In this risk study forklift transport operations are assumed to belong to the handling phase while truck transport is not.

3.1.3. Onsite Transport

Onsite transport encompasses all truck transfer operations outlined above at the sending and receiving sites. Associated risks consist of truck collision and/or overturn accidents with the munitions configured in ONC or OFC packages (or spray tanks and Weteye bombs in overpacks during transfer from the storage facilities to the demilitarization facility). These risks depend upon the expected distance of truck travel.

At all sending sites, the truck transfer distance from storage to the holding area is assumed to be one mile. For air transport, the departure and the arrival air strips were assumed to be located one mile each from the respective holding areas.

At the disposal site, one mile distances are assumed between the receiving holding area and interim storage and between interim storage and the MHI.

3.1.4. Offsite Transport - Rail

Special munitions trains will be used for rail transportation. Each munition train will be preceded by a pilot train. The munitions train is so configured that cars are divided into groups with buffer cars containing inert material between the groups. Special administrative procedures and controls are used to assure track and equipment reliability, as described in Appendix G. This study assesses the risks due to internally caused train accidents, due to human error or equipment (switching, etc.) failure, as well as externally caused events, such as aircraft crash, earthquake, and tornado, while the train is enroute to the receiving stations. The enroute risks consider the number of rail miles involved for specific site transfers.

Loading or unloading a munitions train is estimated to take approximately one day. During this time, the munitions on the train are susceptible to externally caused accidents.

3.1.5. Offsite Transport - Air

An option of using air transport to move munitions from either APG or LBAD sending sites to the Tooele depot receiving site was evaluated. Actual air flight distances were factored into the risk analysis. These are 1540 and 2066 miles, respectively, from LBAD and APG, pertaining to specific routes which avoid major population centers. The type of military aircraft (affecting the number of flights needed) assumed for this analysis was either C-141 or C-5. The availability of these aircraft during the demilitarization campaign is unknown at this time.

3.1.6. Offsite Transport - Ship

This study examines a specific option of moving mustard-filled ton containers from APG, Maryland, to JACADS. The analysis was based on using the LASH shipping system (lighter aboard ship). In this system,

the ton containers are loaded into vaults and trucked to an onsite dock. At the dock, the vaults will be loaded on barges (called lighters) at a loading facility to be constructed on installation property on the Bush River. The barges are towed to the ocean-going LASH vessel anchored nearby in the deeper water of the Chesapeake Bay. The barges with the cargo onboard are lifted onto the LASH vessel, which is designed to carry preloaded barges in the hold. The LASH ship will then sail southward in the Chesapeake Bay, south along the east coast of the United States and Central and South America, around Cape Horn, then across the Pacific Ocean to Johnston Atoll. The ship is then off-loaded in the reverse order at the Johnston Atoll dock.

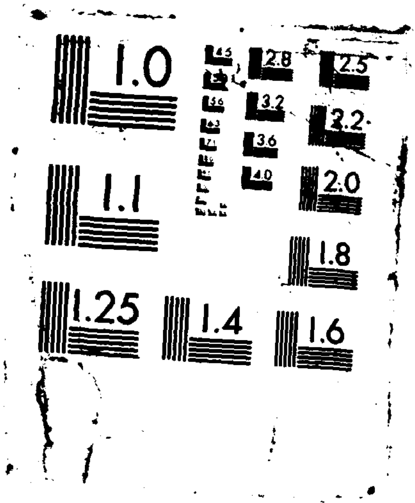
Risks associated with this ship transport involve internally (mostly human error) caused accidents, such as vessel collisions, bridge or shore rammings or groundings. Also considered are externally caused events, namely on-board fires, heavy weather damage, or aircraft crash.

3.1.7. Plant Operations

The demilitarization activity involves all processes present in a JACADS-type demilitarization facility including removal and deactivation of explosives, draining and incineration of agent, and treatment of all process effluents and ventilation air. For this study, the demilitarization facility is defined to be the MHI, where munitions await processing, and the MDB, where the incineration occurs.

In the MDB the munitions are first unpacked in the UPA. They are then processed by conveyor to the burster removal area, mine punch-and-drain area, projectile mortars disassembly area, rocket and burster shearing machines, mine machine for booster removal, a bulk drain station to punch and drain bulk items, a TOX agent storage tank, furnaces for explosive deactivation, metal parts decontamination, and agent and dunnage incinerators, as appropriate.

AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF 2/13
THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO
CA A W BARSELL ET AL. AUG 87 GA-C-18563
UNCLASSIFIED SAPEO-CDE-IS-87006 DAAA15-85-D-0022 F/G 15/6.3 NL


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

Risks associated with the plant operations (disposal) phase include internally (human error or equipment) caused accidents resulting in munition drops, spills, and fires or explosions in furnace rooms. Externally caused risks involve tornado, meteorite, aircraft crash, or earthquake events. The potential for such events to fail packaged munitions in the MHI or UPA, bare or punched munitions in the MDB, or TOX piping systems was analyzed.

3.1.8. Decommissioning

After the existing stockpile of lethal chemical agent and munitions at each site has been destroyed, the demilitarization facility will be decommissioned. The activities for cleanup and closure of the destruction facilities, as discussed in Chemical Stockpile Disposal Plan (Ref. 3-1), are as follows:

1. Decontamination of the MDB and laboratory.
2. Disposal of all solid wastes and residues.
3. Certification of the plant and site as nontoxic.

3.2. MUNITIONS DESCRIPTION

This section describes the munitions that comprise the CONUS munitions stockpile. The munitions stored at each site are summarized in Table 3-1. As indicated the inventory of munitions and bulk agent in storage differs greatly from site to site. Detailed information on the precise numbers of chemical agent munitions at each site is classified except for the information on M55 rockets. All of the chemical munitions in storage are at least 18 yr old (production of new chemical munitions was stopped in 1968), and some are more than 40 yr old.

The munitions stockpile consists of 11 different munition types. A detailed description of each munition type, including a discussion of their thresholds, is presented in Appendix F. A brief description of the munitions follows.

3.2.1. Rockets

The M55 rockets are filled with either GB or VX. The rockets are equipped with fuzes and bursters which contain explosives. Propellant is also built into the motor of the rocket. The rocket casing is made of aluminum. Some of the rockets have a leakage problem.

The rockets are individually packaged in fiberglass shipping tubes with metal end caps. Fifteen containers with rockets are packed on a wooded pallet.

3.2.2. Land Mines

Mines contain VX and explosive charges. The mines are packaged three to a steel drum. Mine activators and fuzes are packaged separately in the same drum. Twelve drums of mines are contained on a wooden pallet.

TABLE 3-1
DATA FOR ONSITE TRANSPORT CONTAINERS (ONC), VAULTS,
AND OFFSITE TRANSPORT CONTAINERS (OFC)

<u>Size</u>:

ONC: 6-ft diameter x 8-ft long cylinder

OFC: 20 ft x 8 ft x 8 ft

Vault: 8.8 ft x 3.7 ft x 4.5 ft

<u>Failure Criteria</u>:

Exposure to engulfing 1850°F fire detonates bursterd munitions

ONC: 15 min

OFC: 30 min

Vault: not used for burstered munitions

Exposure to engulfing 1850°F fire thermally fails munitions

ONC: 15 min

OFC: 2 h

Vault: 2 h

Impact failure:

ONC: 40-ft drop (35 mph)

OFC: 40-ft drop (35 mph)

Vault: 40-ft drop (35 mph)

Puncture:

ONC: velocity/radius = 100/s

OFC: velocity/radius = 200/s

Vault: velocity/radius = 200/s

Crush:

ONC: 50,000-lb static load

OFC: <520,000-lb static load

Vault: <520,000-lb static load

3.2.3. Projectiles and Mortars

The munitions stockpile contains 105-mm projectiles with GB or mustard, 155-mm projectiles with GB, VX, or mustard, 8-in. projectiles with GB or VX, and 4.2-in. mortar projectiles with mustard. Some 105-mm projectiles are stored as complete rounds containing fuze, burster with explosive, cartridge case and propellant, while others are stored without bursters, fuzes and propellant. Mortars are stored with fuzes, bursters, and propellants. 155-mm and 8-in. projectiles are also stored with and without bursters. For this study, it was assumed that fuzes and propellants have been removed from the 4.2-in. mortars and 105-mm cartridges.

The 105-mm projectiles are packed 24 projectiles to a pallet; the 4.2-in. mortar projectiles are packed 48 projectiles to a pallet.

155-mm and 8-in. projectiles are packaged eight and six projectiles on a wooden pallet, respectively.

3.2.4. Bombs

There are three types of bombs, all containing GB agent. These are the MC-1, a 750-lb bomb, the MK-94, a 500-lb bomb, and the MK-116 ("weteye"), a 525-lb bomb. The 525-lb bomb is designed to release an aerosol spray of agent on detonation. The bombs are stored without explosives. The MC-1 bombs are packaged two to a wooden pallet and the others in individual metal shipping containers.

3.2.5. Spray Tanks

Spray tanks contain VX agent. They are designed for releasing chemical agent from slow-traveling, low-flying aircraft. The spray tanks are stored in a metal overpack container.

3.2.6. Bulk Agent

All three types of agent are stored in bulk as liquid in standard one-ton steel containers (called ton containers). Ton containers are not palletized.

Ton containers are the only items stored at the Aberdeen Proving Ground (APG) and Newport Army Ammunition Plant (NAAP). The ton containers at APG contain mustard (HD), while NAAP has VX-filled ton containers. The Anniston Army Depot (ANAD) has filled ton containers. Pine Bluff Arsenal (PBA) has mustard-filled ton containers. Tooele Army Depot (TEAD) has all types of bulk agent in storage. Umatilla Depot Activity (UMDA) has mustard-filled ton containers.

3.3. MUNITION PACKAGING AND TRANSPORT

For offsite transport by air or rail, the munitions will be packaged in offsite transport containers (OFCs) at the storage facility of the sending site. They will remain in OFCs until arrival at the disposal site storage. Transport from the disposal site storage to the demil facility is done with munitions in onsite transport containers (OFCs). Offsite transport of ton containers by marine shipment is done with the TCs in vaults. Table 3-3 presents the failure criteria for these munitions packages (Ref. 3-1).

Leakers may be caused by the corrosive nature of the chemical agent on the materials in the munitions agent compartment wall. When leakers are detected in storage, the munitions are packaged in a special leak-proof package. No munitions known to be leaking are ever transported unless they are packaged in a special leak-proof package. Realistically, the major impact of corrosion is to degrade the original materials such that, while a leak has not occurred, the material parameters upon which the calculated failure thresholds are based generally do not reflect the actual condition of the munitions. The extent of degradation is unknown and cannot be considered in a meaningful way in the analyses presented in this report. Therefore, a general assumption is that the effect of corrosion or other material degradation is neglected, and a leak is assumed not to be initiated in transport.

If the accident forces are sufficiently severe to cause the OFC to fail, then those munitions with a lower failure threshold are also assumed to fail so that agent release occurs. If the failure threshold of the individual munition is higher than the OFC package, the munition failure threshold is used. In other words, the failure threshold of the package and contained munitions combined is equal to the maximum of either the package threshold or the munition threshold.

It is also assumed that when large fires occur, they engulf the entire transport vehicle. The assumption that the "representative" large fire always engulfs the transport vehicle is very conservative.

The structural calculations are based on the assumption that the munitions impact an unyielding surface, but because such surfaces are seldom encountered in real accidents, the structural failure thresholds are conservative.

The Sandia National Laboratory (SNL) transportation data base (see Sections 8 and 9) is assumed to be applicable to military transport. Where appropriate, modifications are clearly indicated to account for administrative controls. The major benefit of using the SNL transportation data base is that, in addition to providing accident rates for impact, fire, etc., the SNL researchers used sophisticated modeling to produce the accident environments that appear in the figures showing the percentage of accidents that do not exceed a certain force. These curves, or accident force spectra, are based on the best data available to SNL and a number of assumptions. The effect of administrative controls is to change either the data or the assumptions used to generate not only the accident rate but also the accident force spectra. Thus, a major assumption in this report is that when the accident rates are modified to account for factors unique to munitions aircraft, the accident force spectra are essentially unchanged. Use of the SNL curves is conservative, however.

No generally accepted method to quantify the probability of potential sabotage events in a risk analysis has been developed. Thus, any change in sabotage risk which occurs when extra packaging is used is not included in a quantitative way.

The shipping will be accomplished using the LASH (lighter aboard ship) shipping system. In this system, the ton containers will be loaded into vaults at their current storage location, and then trucked

to an onsite dock. At the dock, the packages will be loaded on barges (called lighters) at a loading facility to be constructed on installation property on the Bush River. The lighters will be towed to the ocean-going LASH vessel anchored nearby in the deeper water of the Chesapeake Bay. The lighters with the munitions on board are lifted onto the LASH vessel, which is designed to carry preloaded lighters in the cargo holds. The LASH ship will then sail southward in the Chesapeake Bay, south along the east coast of the United States and Central and South America, around Cape Horn, then across the Pacific Ocean to Johnston Island. The ship will then be off-loaded in the reverse order at Johnston Island.

The mustard-filled ton containers at Aberdeen Proving Ground will be transported to the dock in the vaults and loaded into the lighters. It is assumed that a towboat will then transport the lighters, 10 at a time, to a LASH vessel anchored in deeper water within the Chesapeake Bay. The lighters will be lifted by crane onto the LASH vessel and loaded into the ship's cargo hold.

Once the LASH vessel has been loaded, the ton containers will be transported south through the Chesapeake Bay, around South America, and across the Pacific Ocean to Johnston Atoll. This distance, approximately 14,000 nautical miles, is shorter than earlier proposed routes and was selected in order to eliminate the risk from refueling. Due to the significantly increased risk of an accident occurring during the transport if the ship is required to go into port to refuel or is refueled during transit, it is also assumed that the LASH vessel will have adequate fuel for the entire journey.

As the LASH vessel proceeds down the Chesapeake Bay, tugs will be used to assist the LASH under bridges and as otherwise needed to increase the maneuverability. This, in turn, will reduce the risk.

An escort ship will accompany the munitions ship on the voyage. The escort ship will carry support personnel and equipment sufficient to respond to an emergency aboard the LASH ship that cannot be handled by onboard personnel.

It was also assumed that no lighters would be stored above deck for the transit. This was done to decrease the risk of transport.

3.4. REFERENCES

3-1. Reed, A., et al., "Analysis of Existing Hazardous Material Containers for Transporting Chemical Munitions," the MITRE Corporation, June 1987.

4. INITIATING EVENTS

This section describes the approach used to identify and select initiating events and to assess or present their occurrence frequencies. As described in Section 2, initiating events are single occurrences or individual malfunctions that either directly cause the release of chemical agents or start a sequence of events that could lead to a release. They are classified as external events when caused by natural phenomena (e.g., earthquakes) or man-made interferences (e.g., aircraft crashes) from outside the demilitarization cycle. They are classified as internal events when caused by human error or equipment failure within the demilitarization process. Section 4.1 describes the logic used for selection of the initiating events. Section 4.2 discusses the generic considerations in specifying the initiating event frequency units (i.e., per unit time or per operation). The application of the generic frequency estimates to specific accident scenarios, locations and demilitarization phases are discussed in the sections dealing with accident logic model development, Sections 5 through 8.

4.1. INITIATING EVENT IDENTIFICATION AND SELECTION

This study used a multifaceted approach for identifying potential initiating events, screening out those which (based on conservative scoping) should not affect the overall risk and selecting those events warranting further analysis. The approach consisted of:

1. Developing a master logic diagram (MLD), a logic tool described in the PRA Procedures Guide (Ref. 4-1) for systematically examining potential modes of release, pathways for release, barriers against release, and mitigating safety functions together with root causes (initiators) of release.

2. Dividing the demilitarization facility (MDB) into spatial zones and examining potential sources of release in each zone to identify internal initiating events for plant operations.

3. Cross-referencing results from items 1 and 2 with a list of accident scenarios from safety related studies on the chemical weapons disposal program, compiled by the MITRE Corporation in Ref. 4-2.

4. Applying previous munitions risk study experience in Refs. 4-3 through 4-11. (The results of these studies are described in Section 1.1.)

5. Peer review by the Army and independent consultants during the early and draft report phases of this study.

Two criteria were used to screen accident scenarios: (1) accidents with extremely low frequency (below 10^{-10} per year), (2) those with low consequences (amount of agent release below 0.3 lb for GB, 14 lb for H or 0.4 lb for VX) were also screened. Events with frequencies below the cutoff have little meaning from a practical standpoint since the expected times between events is measured on a cosmic scale rather than on a scale of human history. The consequence criteria pertain to the minimum release levels that would produce acute human fatalities 0.5 km from the incident, based on environmental impact calculations performed by MITRE (Ref. 4-2).

For bookkeeping purposes, a coding system is used in this report to identify, organize, and refer to accident sequences. Not all accident sequences were encoded; those that could be screened out early because of simple conservative scoping analysis bear no coding. Conversely, many sequences that were screened after detailed analysis retain their coding but may not be in the final lists of results. However, Appendix A contains a record of all encoded sequences.

Table 4-1 shows the coding scheme followed for identification of accident sequences. The coding system is based on that used in Ref. 4-2. The first two letters identify the demilitarization phase (S for storage, H for handling, R for rail transport, V for truck transport, B for barge transport, L for LASH transport, and P for plant operations) and the offsite transport mode option or division of activities for that phase, if any. For example, VR, VA, and VW refer to onsite transport for rail, air, or marine options. The first two letters together with the sequence number at the end uniquely identify an accident sequence of events. The middle letters identify the munition/agent type combinations and the release mode. Throughout this report, either the entire coding is used or sequences are referred to by the first two letters and the sequence number.

The MLD developed for the risk study event identification is shown in Figs. 4-1 through 4-9. Following the PRA Procedures Guide (Ref. 4-1), the top level logic (Fig. 4-1, level 1) pertains to the public impact, in this case, exposure to chemical releases throughout the various phases of the demilitarization process (storage, plant operations, handling, onsite transport and offsite transport).

Figure 4-2 shows MLD level 2 (release mode or pathway) and subsequent levels (barriers to release, safety functions mitigation/failure and, finally event initiators) for storage, including interim storage. It shows three modes for release. One is leakage of agent from corroded munitions, such as leakage of a ton container stored in open areas. Another is inadvertent rupture of a munition during maintenance. The third is a disruptive influence due to an external event. Since handling associated with incoming and outgoing munitions are considered in the handling phase, these three modes logically represent the possible ways a release can occur in the storage phase.

Subsequent levels are developed considering the types of disruptive events that can occur, taking into account information on the potential

TABLE 4-1
ACCIDENT SEQUENCE CODING SCHEME

The Accident Scenario Identification is an 8-Character Code for the Form: XXYZWnnn as Defined Below.

Activity (XX)				Munition/Agent Type Combinations (YZ)
	Rail	Air	Ship	
Plant operations	PO	PO	PO	BG: bomb containing GB
				DH: mortar containing H
Storage, long term	SL	SL	SL	CG: cartridge containing GB
				CH: cartridge containing H
Storage, interim	SR	SA	SW	KG: ton container with GB
				KH: ton container with H
Handling, at facility	HF	HF	HF	KV: ton container with VX
				MV: mine containing VX
Handling, onsite	HC	HA	HW	PG: projectile (155 mm) containing GB
				PH: projectile (155 mm) containing H
Truck transport, interim	VO	VO	VO	PV: projectile (155 mm) containing VX
				QG: projectile (8-in.) containing GB
Truck transport, for offsite	VR	VA	VS	QV: projectile (8-in.) containing VX
				RG: rocket containing GB
Offsite transport[a]	RC	AA	BI	RV: rocket containing VX
		AB	LI	SV: spray tank containing VX
			LC	
			LS	

Release Mode (W)	Sequence No. (nnn)
S: Spill or leak	001, 002, 003, ... 999
C: Complex (e.g., detonation with fire)	
F: Fire only	

[a]For air transport, AA is for C-5 and AB is for C-141 aircraft. For ship transport, BI covers barge events; LI, LC, and LS are for LASH events in intercoastal, coastal and high-sea waters, respectively.

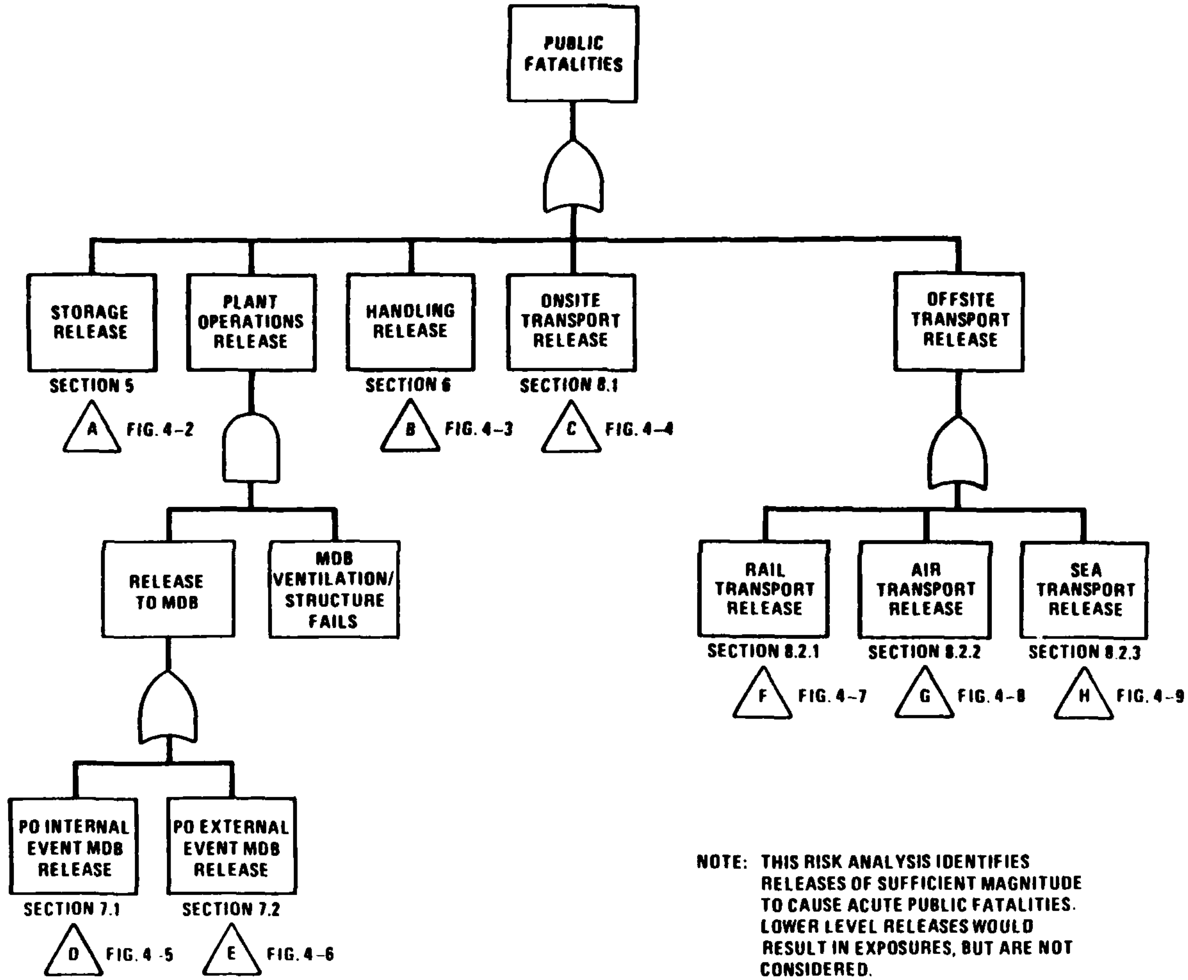
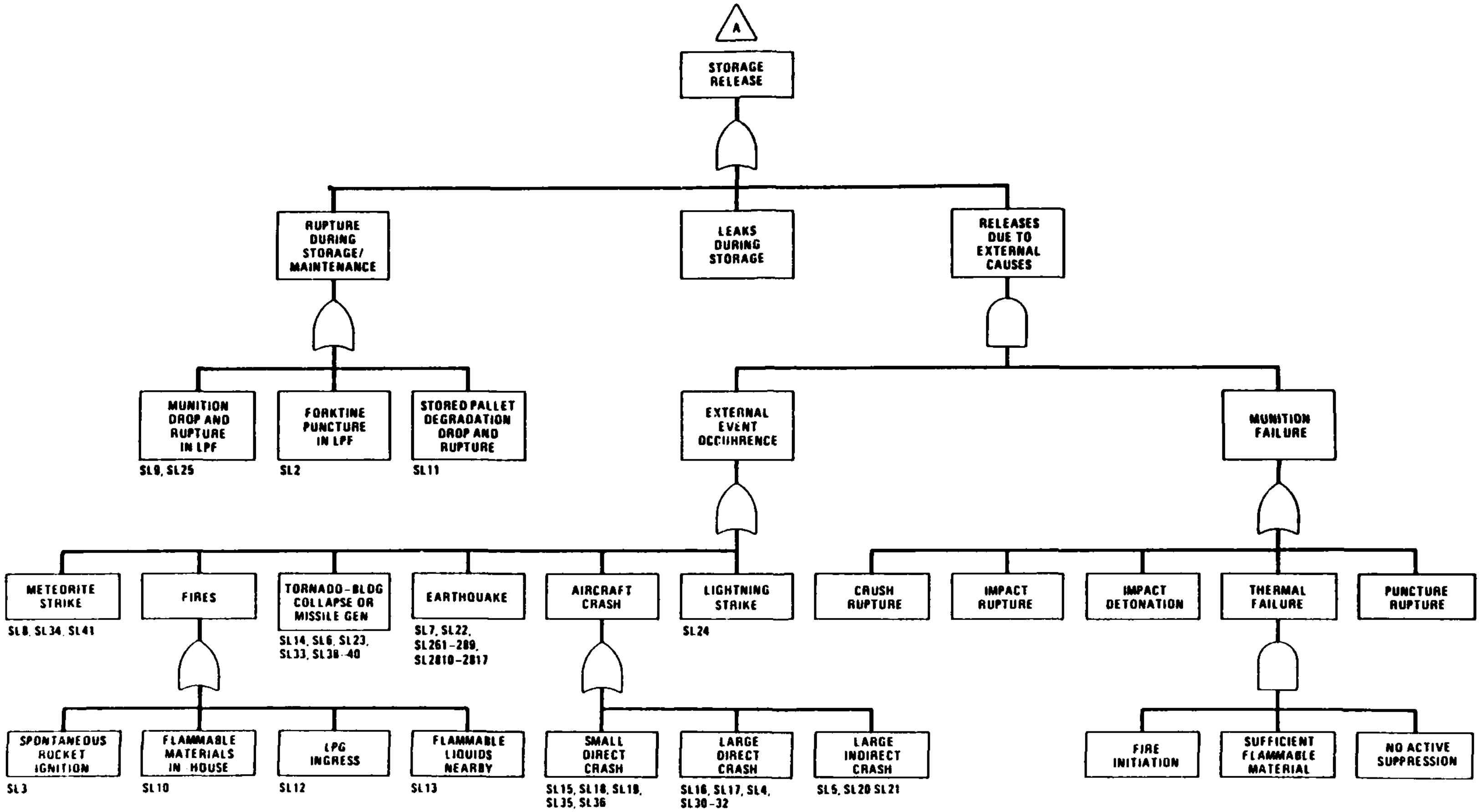


Fig. 4-1. Master logic diagram - level 1 (public impact) for the collocation options of the chemical demilitarization cycle



NOTE THERE ARE ADDITIONAL STORAGE SEQUENCES ASSOCIATED WITH HOLDING AREAS

Fig. 4-2. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part A - storage release

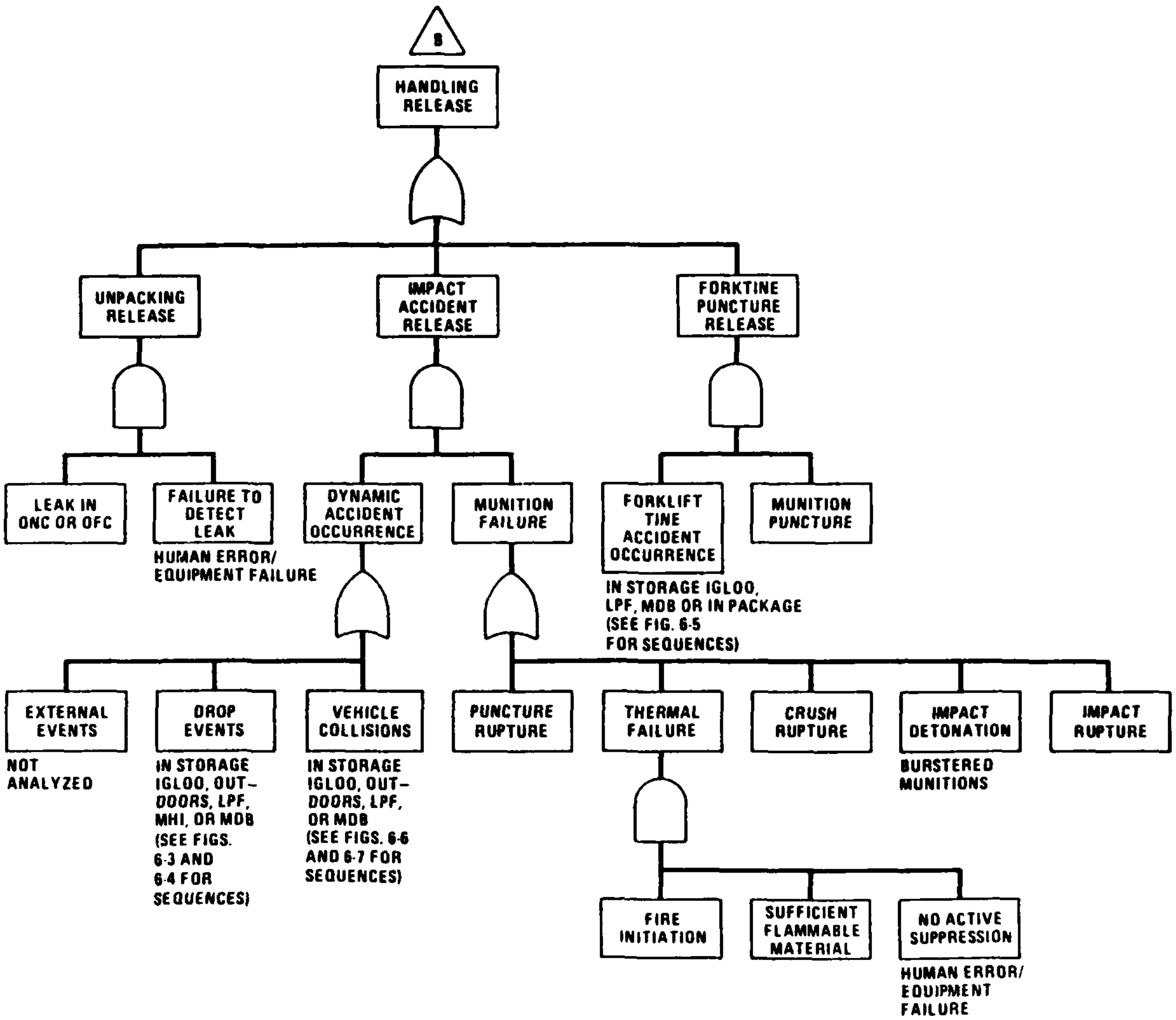


Fig. 4-3. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part B - handling release

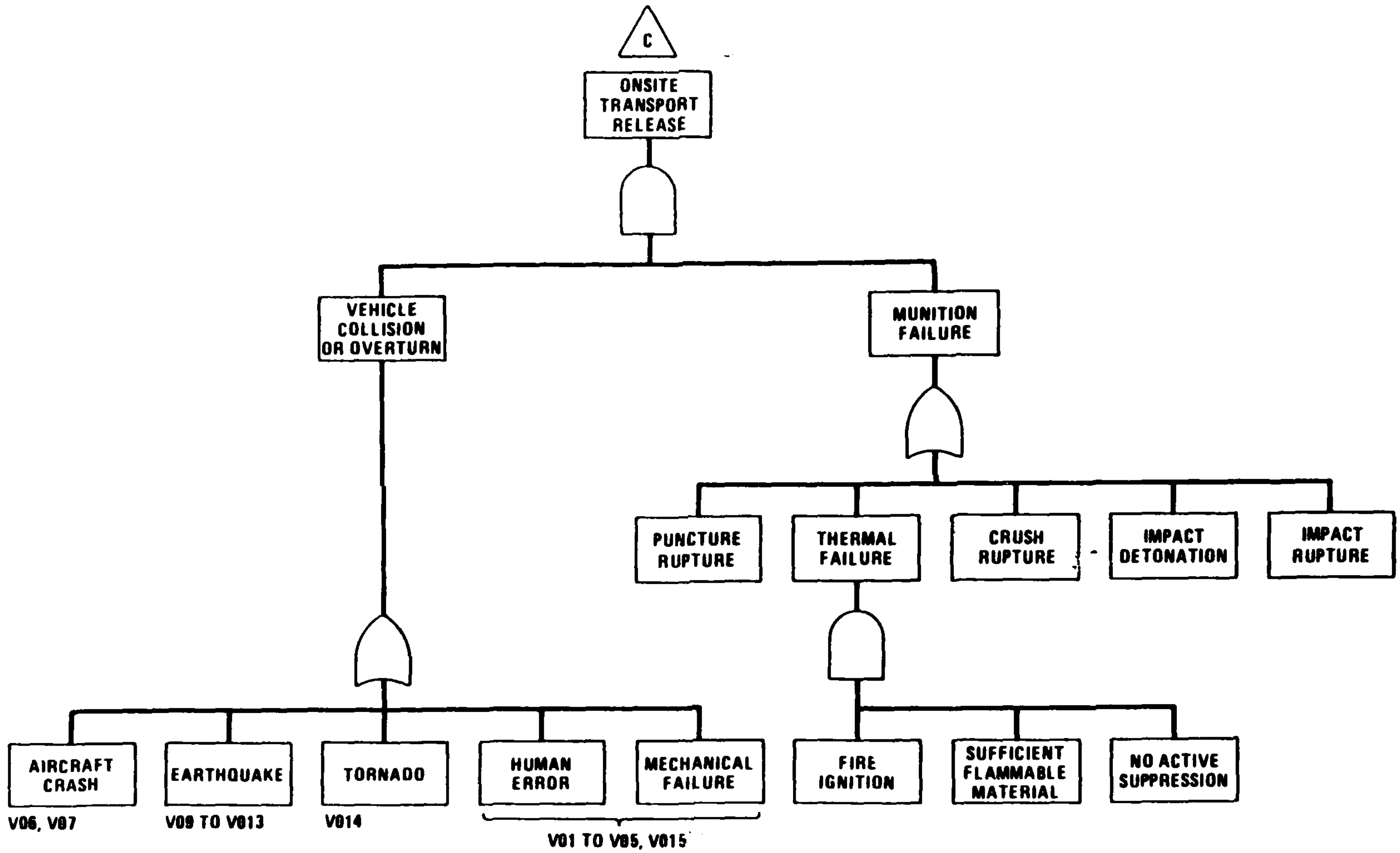


Fig. 4-4. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part C - onsite transport release

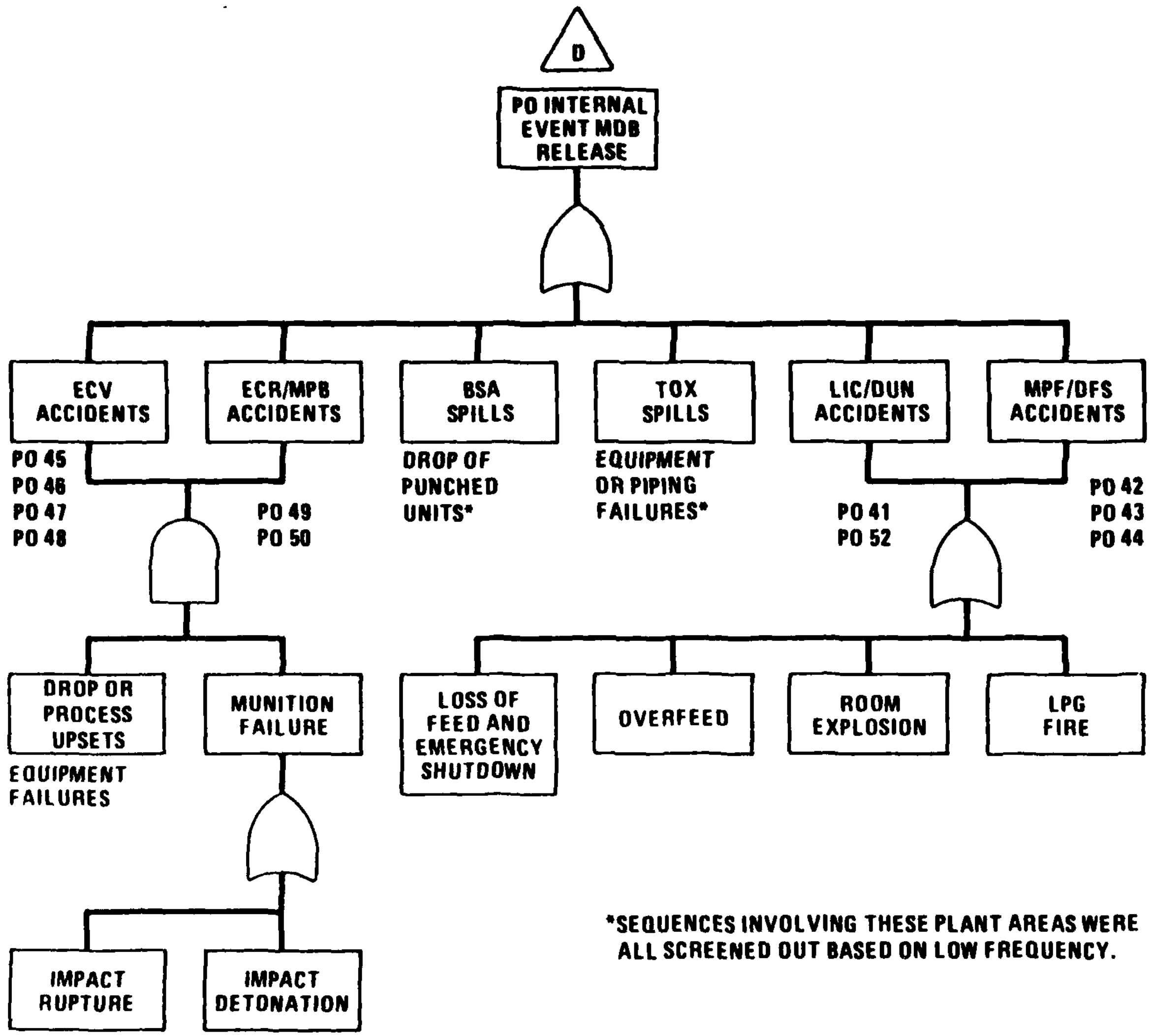


Fig. 4-5. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part D - plant operations internal events

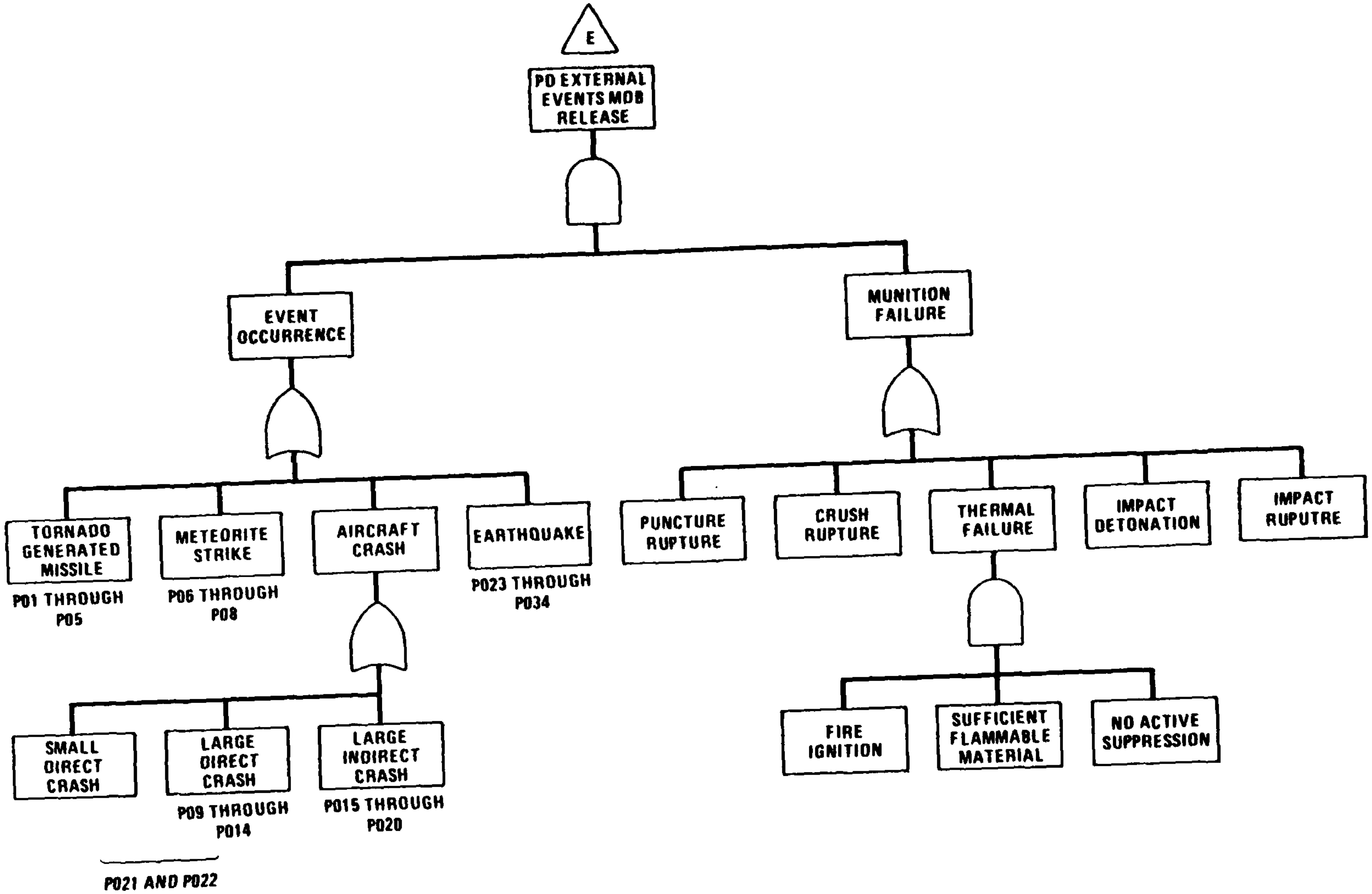


Fig. 4-6. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part E - plant operations external events

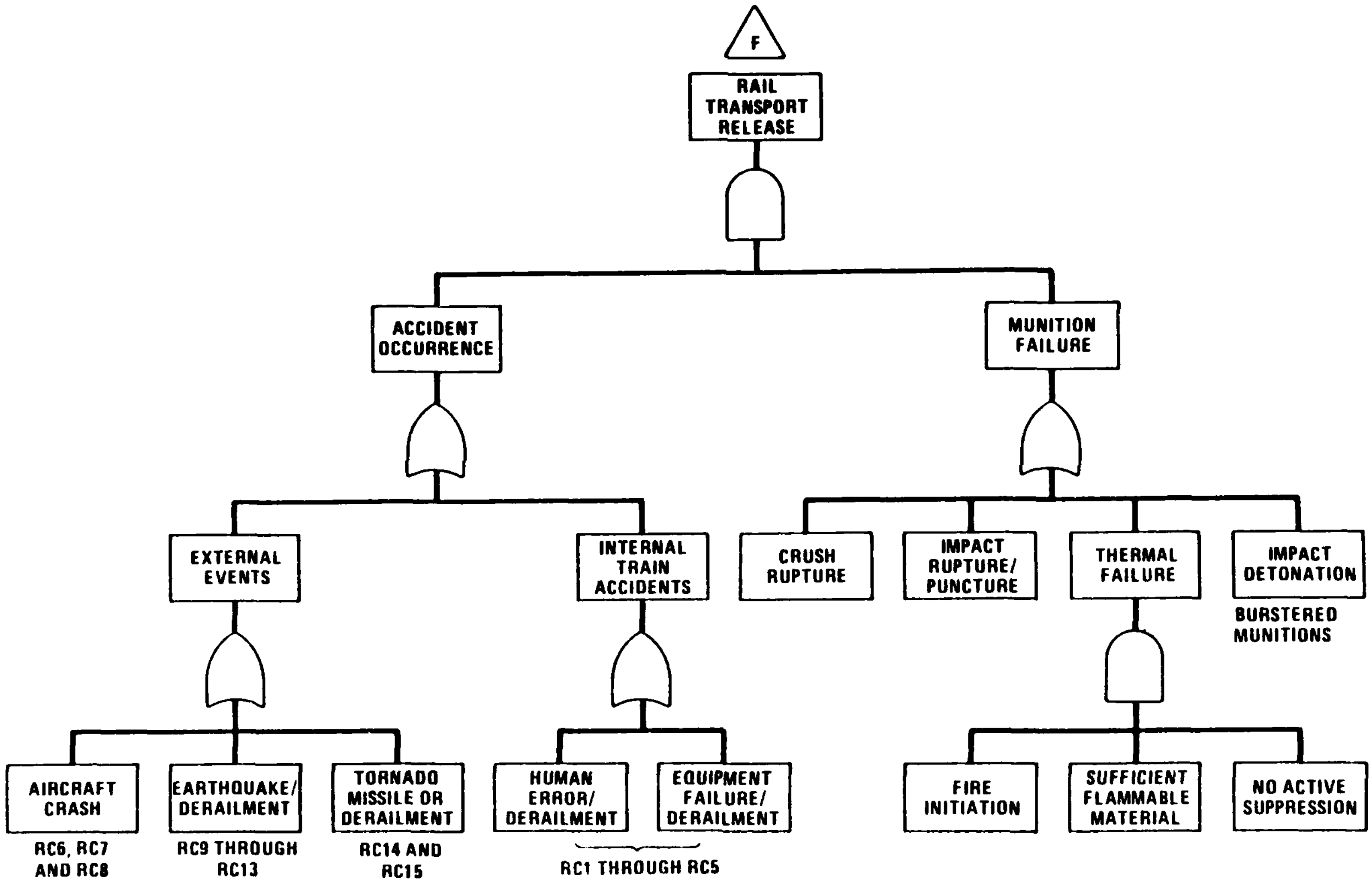


Fig. 4-7. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part F - offsite rail transport

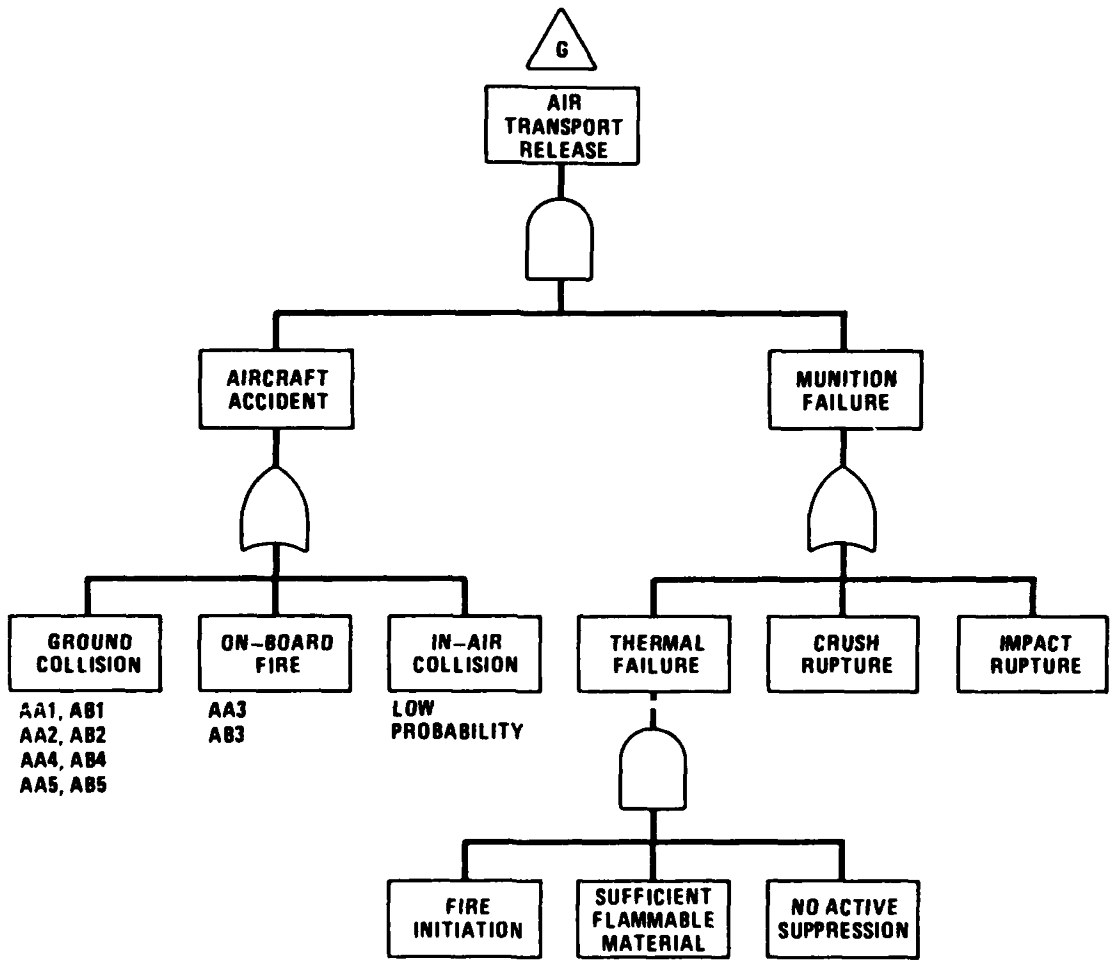


Fig. 4-8. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part G - offsite air transport

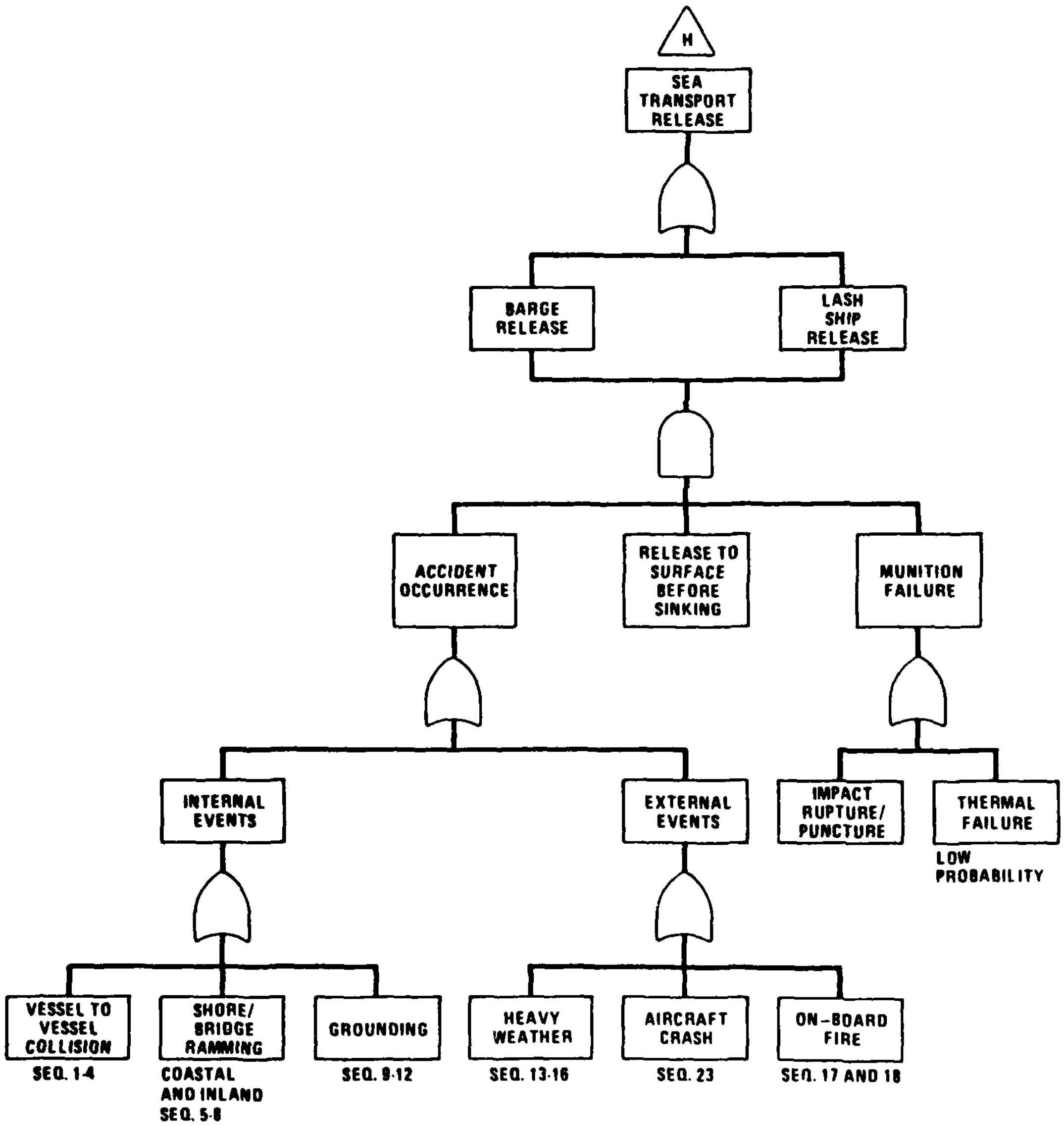


Fig. 4-9. Master logic diagram - levels 2 (release pathway) and lower (barriers, safety functions, and initiators). Part H - offsite sea transport

failure modes of the munitions (puncture, detonation, fire, etc.), given that the event occurs. For illustration, some sequences analyzed in Section 5 are noted under the initiating event boxes. Table 4-2 summarizes the initiating event families for storage selected for analysis.

Figure 4-3 shows the MLD levels 2 and lower for handling operations. There are three modes of release: release due to unpacking of undetected leakers, impact rupture due to handling accidents (drops and forklift collisions), and forklift tine puncture. Note that external events are not included here; external events for storage and transport consider the entire munitions inventory available regardless of whether handling operations are in progress. The subsequent level initiating events consider the location where the event occurs (e.g., if the event occurs indoors or in an open area), since different barriers for release are involved. Table 4-3 summarizes the families or handling initiating events selected for analysis.

The MLD for onsite truck transport is developed in Fig. 4-4. A single generic mode of release applies to this phase, involving a vehicle collision or overturn coupled with potential munitions failure modes. In this phase, the munitions are always in offsite or onsite transport containers or overpacks, and failure thresholds may differ from those for bare munitions. Table 4-4 summarizes the initiating event families analyzed for onsite transport.

Figure 4-5 shows the MLD level 2 and subsequent levels for internal events during plant operations. This portion of the MLD was constructed by dividing the MDB into spatial zones and examining the sources for agent release in each zone. The zones are as follows:

1. The explosive containment vestibule (ECV) and munitions corridor.

TABLE 4-2
INITIATING EVENT FAMILIES FOR STORAGE

INTERNAL EVENTS

1. Munition drop

   a. During leaker isolation
   b. Due to pallet degradation

2. Forklift tine puncture during leaker isolation

3. Leak between inspections

EXTERNAL EVENTS[a]

1. Fires due to

   a. Spontaneous ignition of a rocket
   b. Flammable materials in an igloc or warehouse
   c. LPB ingress into an igloo or warehouse
   d. Flammable liquids near a warehouse at NAAP

2. Meteorite strikes an igloo, warehouse, or interim storage holding area

3. Tornado collapses a building or generates a missile

4. Aircraft crash due to

   a. Small aircraft (direct)
   b. Large aircraft (direct)
   c. Large aircraft (indirect)

5. Earthquake

6. Lightning strikes outdoor storage

---

[a]Note: Floods are shown in Section 5 to be unimportant initiators.

TABLE 4-3
INITIATING EVENT FAMILIES FOR HANDLING[a]

1. Drop during operations at the processing facility of a
   a. Pallet or ONC outdoors
   b. Pallet or ONC in the MDB
   c. Single munition in the MDB

2. Drop during operations outside the facility of a
   a. Pallet or ONC in a storage igloo
   b. Pallet or ONC outdoors
   c. ONC in the MHI
   d. Pallet or OFC in the LPF
   e. Single munition in the LPF
   f. OFC outdoors

3. Forklift tine puncture of a
   a. Bare munition in a storage igloo
   b. Bare munition in the LPF
   c. Bare munition in the MDB
   d. ONC or OFC outside the facility
   e. ONC or OFC at the facility

4. Forklift collision at the processing facility for a
   a. ONC outdoors
   b. ONC in the MDB

5. Forklift or CHE collision outside the facility for a
   a. Palletized munition outdoors
   b. Palletized munition in a storage igloo
   c. Bare munition in the LPF
   d. ONC outdoors
   e. OFC in the LPF
   f. ONC in the MHI
   g. OFC outdoors

6. Failure to detect a leak in an ONC or OFC

---

[a] For the marine transport option, vaults are used instead of OFCs.

TABLE 4-4
INITIATING EVENT FAMILIES FOR ONSITE TRUCK TRANSPORT

INTERNAL EVENTS

1. Truck collision or overturn due to human error or equipment failure
   a. With fire
   b. Without fire

EXTERNAL EVENTS

1. Aircraft crash into a truck
   a. With fire
   b. Without fire
2. Earthquake causes a truck collision or overturn
   a. With fire
   b. Without fire
3. Tornado causes a truck collision or overturn
   a. With fire
   b. Without fire

2. The munitions processing systems within the explosive containment room (ECR) and the munitions processing bay (MPB).

3. The buffer storage area (BSA), particularly punched and drained units present there.

4. The TOX tanks and associated piping systems.

5. The furnaces (MPF and DFS) and incinerators (LIC and DUN) and associated rooms.

For zones 1 and 2, the munitions present are unpunched. Thus, both a fall or other upset <u>and</u> a failure of the munition casing must occur for an agent spill. In zone 3, only the event is needed since the munitions are punched. Zone 4 refers to vessels and piping containing liquid agent; failure or rupture of safety grade metallic barriers are required for spills. Should spills occur in zones 1 through 4, they would drain to the appropriate sump. Evaporation from the floor and sump or a possible burning of the spill could result in a release to the environment if the MDB ventilation system or building structure fails. Zone 5 includes furnace and incinerator rooms where the release pathway is via accidental explosions.

Figure 4-6 shows the corresponding diagram logic diagram for release due to external events during plant operations. Here, the conditional failure of the MDB structure may be more likely or certain, given the catastrophic nature of the external events, such as meteorite strike or aircraft crash. Table 4-5 summarizes the initiating event families for plant operations.

Figures 4-7, 4-8, and 4-9 show the logic for agent release during offsite transport by rail, air or sea, respectively. For the first two transport options, release is contingent on the accident occurrence <u>and</u> munition failure. In the sea transport case, a liquid agent release to

TABLE 4-5
INITIATING EVENT FAMILIES FOR PLANT OPERATIONS

INTERNAL EVENTS

1. Accident in the ECV fails a munition
2. Accident in the ECR or MPB fails a munition
3. Accident in the BSA causes a punched munition spill
4. Failure of TOX tank or piping causes a spill
5. Accident associated with a furnace or incinerator which releases agent vapor

EXTERNAL EVENTS

1. A tornado generated missile fails
   a. MHI munitions
   b. UPA munitions
   c. TOX/BDS piping (outdoor for CAMDS)
2. A meteorite fails
   a. MHI munitions
   b. UPA munitions
   c. TOX/BDS piping
   d. Agent collection tanks in TOX
3. A direct large aircraft crash fails
   a. MHI munitions
   b. UPA munitions
   c. TOX/BDS piping (outdoor for CAMDS)
   d. Agent collection tanks in TOX
4. An indirect large aircraft crash fails
   a. MHI munitions
   b. UPA munitions
   c. Agent collection tanks in TOX
5. A direct small aircraft crash fails TOX/BDS piping (outdoor for CAMDS)
6. An earthquake fails
   a. MHI munitions
   b. UPA munitions
   c. Agent collection tanks in TOX
7. A truck accident fails
   a. TOX/BDS piping (outdoor for CAMDS)

the surface of the water before sinking is needed in addition, in order for an evaporative release to occur. Table 4-6 summarizes the initiating event families for offsite transport.

TABLE 4-6
INITIATING EVENT FAMILIES FOR OFFSITE RAIL, AIR, OR SEA TRANSPORT

RAIL TRANSPORT

1. Train accident due to human error or equipment failure
2. Aircraft crash onto a train
3. Earthquake causes a train derailment
4. Tornado winds or missiles cause a train derailment

AIR TRANSPORT

1. Aircraft crash into ground
    a. Severe collision fails munitions by impact or fire
    b. Moderate collision causes fire
2. On-board fire causes thermal failure of munitions

SEA TRANSPORT (barge or LASH vessels)

INTERNAL

1. Vessel collision fails munitions
2. Shore or bridge ramming fails munitions
3. Grounding fails munitions

EXTERNAL

1. Heavy weather fails munitions
2. On-board fire fails munitions
3. Aircraft crash into barge or LASH vessel fails munitions

4.2. INITIATING EVENT FREQUENCIES

4.2.1. External Events

This section presents the site-specific frequencies of external initiating events considered in this study. Table 4-7 summarizes the results for occurrences at each of the eight CONUS sites. Table 4-8 presents the nonsite specific occurrence frequencies. The bases for these results are discussed in the following subsections.

4.2.1.1. Earthquakes. The frequency at which a major earthquake occurs at a specific site varies significantly throughout the U.S. (Table 4-9). In an attempt to quantify the seismic risk associated with a particular site, the Seismology Committee of the Structural Engineers Association of California (SEAOC) has divided the U.S. into five seismic zones. Maps of these seismic zones are presented in the Uniform Building Code (Ref. 4-11) and in Army TM 5-809-10 (Ref. 4-12). Figure 4-10 presents the seismic zone map from TM 5-809-10, and Table 4-9 presents the seismic zones indicated for each of the storage sites. The probability of seismic damage in each of the zones is defined in Ref. 4-11 as follows:

Zone 0 - None
Zone 1 - Minor
Zone 2 - Moderate
Zone 3 - Major
Zone 4 - Great

The determination of a seismic zone of a site is based on the history of past earthquakes and the proximity of known faults. Appendix D presents listings of the earthquakes that have occurred in the vicinity of each of the storage sites. The magnitudes of the earthquakes are expressed as Modified Mercalli Intensities (MMI). Table 4-9 presents a summary of the maximum earthquake occurring in the vicinity of each of

TABLE 4-7
SITE SPECIFIC FREQUENCIES OF EXTERNAL INITIATING EVENTS

	APG	ANAD	LBAD	NAAP	PBA	PUDA	TEAD	UMDA
Large aircraft crash (events/yr-mi^2)	5.3×10^{-7}	7.9×10^{-6}	4.5×10^{-6}	4.6×10^{-6}	1.5×10^{-6}	5.9×10^{-5}	3.6×10^{-7}	1.5×10^{-5}
Small aircraft crash (events/yr-mi^2)	7.8×10^{-3}	1.2×10^{-5}	1.8×10^{-7}	2.3×10^{-5}	1.1×10^{-4}	1.0×10^{-4}	1.5×10^{-5}	1.2×10^{-5}
Meteorite (>1.0 lb) strikes (events/yr-ft^2)	6.4×10^{-13}	6.4×10^{-13}	6.4×10^{-13}	6.4×10^{-13}	6.4×10^{-13}	6.4×10^{-13}	6.4×10^{-13}	6.4×10^{-13}
Lightning (events/yr-mi^2)	7.8	23.2	23.3	12.9	28.5	10.4	7.8	5.2
Earthquakes (events/yr)								
- 0.15 g	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	7.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	4.0×10^{-3}	1.5×10^{-4}
- 0.2 g	7.0×10^{-5}	7.0×10^{-5}	7.0×10^{-5}	3.6×10^{-4}	7.0×10^{-5}	7.0×10^{-5}	2.0×10^{-3}	7.0×10^{-5}
- 0.25 g	4.0×10^{-5}	4.0×10^{-5}	4.0×10^{-5}	2.3×10^{-4}	4.0×10^{-5}	4.0×10^{-5}	1.0×10^{-3}	4.0×10^{-5}
- 0.3 g	2.5×10^{-5}	2.5×10^{-5}	2.5×10^{-5}	1.3×10^{-4}	2.5×10^{-5}	2.5×10^{-5}	7.0×10^{-4}	2.5×10^{-5}
- 0.4 g	1.2×10^{-5}	1.2×10^{-5}	1.2×10^{-5}	5.0×10^{-5}	1.2×10^{-5}	1.2×10^{-5}	2.6×10^{-4}	1.2×10^{-5}
- 0.5 g	6.0×10^{-6}	6.0×10^{-6}	6.0×10^{-6}	2.0×10^{-5}	6.0×10^{-6}	6.0×10^{-6}	1.0×10^{-4}	6.0×10^{-6}
- 0.6 g	3.5×10^{-6}	3.5×10^{-6}	3.5×10^{-6}	1.0×10^{-5}	3.5×10^{-6}	3.5×10^{-6}	4.5×10^{-5}	3.5×10^{-6}
- 0.7 g	2.5×10^{-6}	2.5×10^{-6}	2.5×10^{-6}	7.0×10^{-6}	2.5×10^{-6}	2.5×10^{-6}	2.0×10^{-5}	2.5×10^{-6}
Tornadoes (events/yr)								
- 100 mph windspeed	---	---	---	---	---	---	1.0×10^{-5}	1.0×10^{-5}
- 140 mph windspeed	---	---	---	---	---	---	1.0×10^{-6}	1.0×10^{-6}
- 150 mph windspeed	1.0×10^{-5}	---	---	---	---	1.0×10^{-5}	---	---
- 180 mph windspeed	---	---	---	---	---	---	1.0×10^{-7}	1.0×10^{-7}
- 200 mph windspeed	1.0×10^{-6}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-6}	---	---
- 250 mph windspeed	1.0×10^{-7}	---	---	---	---	1.0×10^{-7}	---	---
- 260 mph windspeed	---	1.0×10^{-6}	1.0×10^{-6}	1.0×10^{-6}	1.0×10^{-6}	---	---	---
- 320 mph windspeed	---	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}	1.0×10^{-7}	---	---	---

TABLE 4-8
EXTERNAL EVENT FREQUENCIES FOR SPECIAL CASES

Event	Frequency
1. Fires	
a. Spontaneous rocket ignition	(a)
b. Flammable material (inside)	(b)
c. LNPG ingress	(c)
d. Flammable liquids nearby	(d)
2. Marine transport events	
a. Heavy weather damage to lighters	3×10^{-9}/trip
b. Heavy weather damage to LASH	3×10^{-9}/trip
c. On-board fire (LASH)	3×10^{-9}/trip
3. Aircraft events	
a. On-board fire, C-141	7.6×10^{-9} accidents/flight-mile
b. On-board fire, C-5	3.2×10^{-8} accidents/flight-mile

[a]Negligibly low probability based on AMSAA report.

[b]Insufficient flammable material in storage areas; analyzed by plant area for the demil facility.

[c]Negligibly low rate of ingress relative to that needed for flammability.

[d]Applies only to NAAP; quantity of flammable material determined to be insufficnet to threaten munitions.

TABLE 4-9
MAXIMUM MODIFIED MERCALLI INTENSITIES (MMI)
IN THE VICINITY OF EACH SITE

Site	Seismic Zone	MMI	No. of Occurrences
Aberdeen Proving Ground (APG)	1	VII	1
Pine Bluff Arsenal (PBA)	1	VI	3
Pueblo Depot Activity (PUDA)	1	VI	1
Umatilla Depot Activity (UMDA)	1	VII	1
Anniston Army Depot (ANAD)	2	VII	1
Newport Army Ammunition Plant (NAAP)	2	VII	1
Lexington-Blue Grass Army Depot (LBAD)	2	VII	1
Tooele Army Depot (TEAD)	3	VIII	2

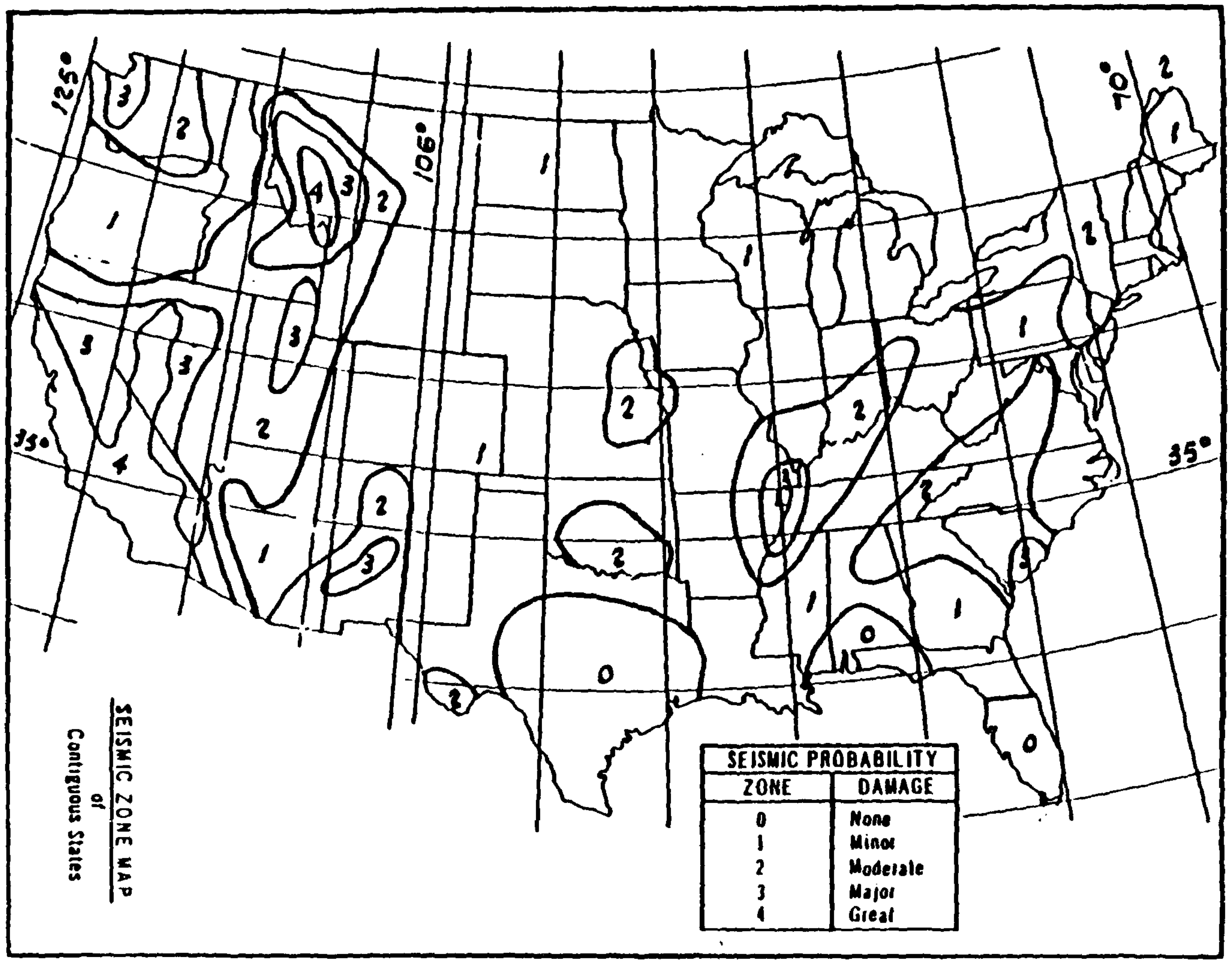


Fig. 4-10. Seismic zone map for the contiguous United States

the storage sites. The maximum earthquake recorded at any of the eight storage sites is an MMI VIII.

Currently, the Applied Technology Council, which is associated with the SEAOC, is developing a new seismic regulations for buildings (Ref. 4-13). When this work is completed, it is expected to be the basis for future federal, state, and local building codes. Part of this work was the development of a seismic risk map which divides the U.S. into seven seismic map areas similar to the five seismic zones used in Refs. 4-11 and 4-12. The seismic risk is approximately constant throughout a seismic map area.

Figure 4-11 (from Ref. 4-13) presents a set of curves that can be used to estimate the probabilicies of earthquakes of various g-levels occurring within a particular seismic map area. The dashed portions of the curves indicate possible extrapolations to larger and smaller annual probabilities. Table 4-10 identifies the seismic map areas for each of the CONUS sites and tabulates the annual frequencies of earthquakes of various g-levels being exceeded at the storage sites. The data in Table 4-10 were obtained from Fig. 4-11. Straight line, logarithmic extrapolation was used to extrapolate to accelerations beyond the curves shown in Fig. 4-11. This method of extrapolation is believed to produce conservative estimates of the probabilities.

4.2.1.2. Wind Hazards. Methods for estimating the frequency and intensity of extreme winds can be found in ANSI/ANS-2.3-1983 (Ref. 4-14). The discussion which follows is largely based on the referenced national standard.

4.2.1.2.1. Tornadoes. A tornado is a violently rotating column of air whose circulation reaches the ground. The velocity of tornadic winds can exceed 300 miles per hour. The path of a tornado can be more than a mile in width, but generally ranges from 1/8 to 3/4 mile wide. The path width is defined as the tornado diameter corresponding to a 75 mph wind

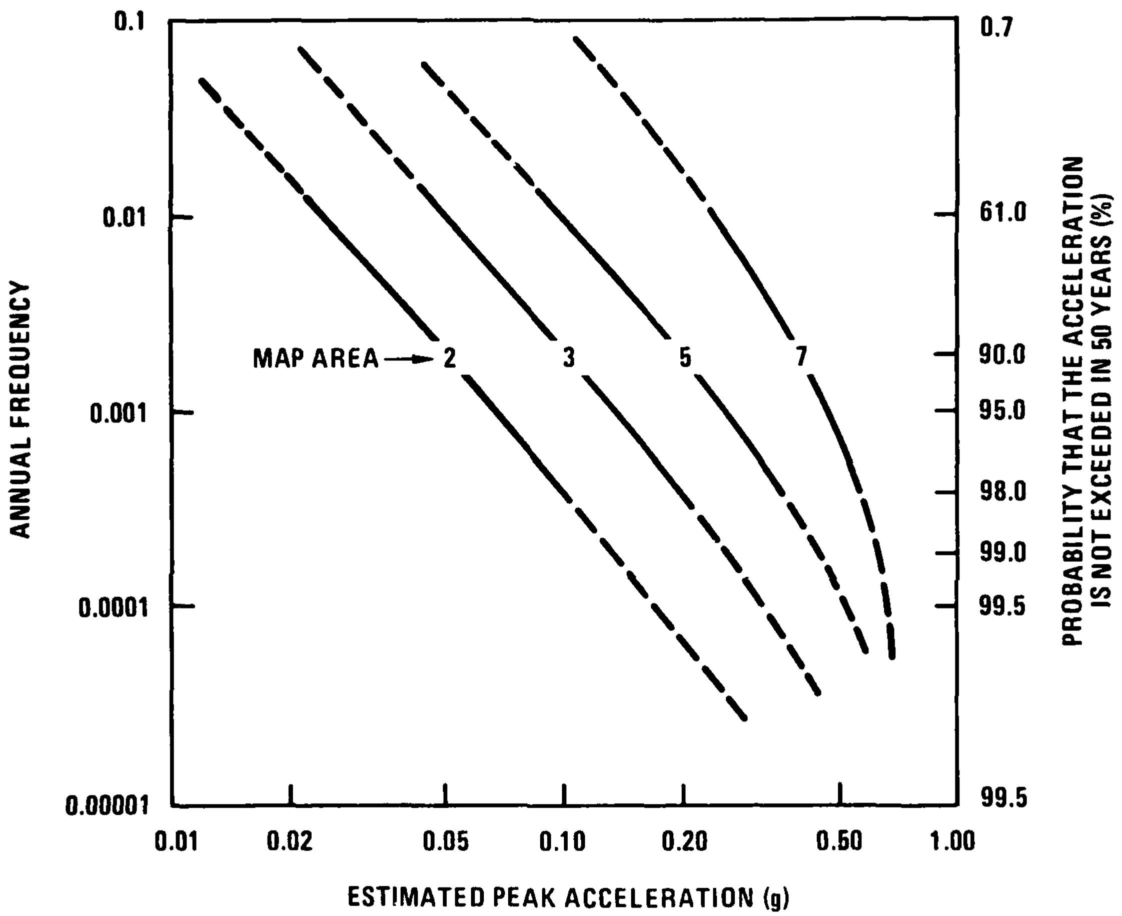


Fig. 4-11. Annual frequency of exceeding various effective peak accelerations for selected map areas defined by the Applied Technology Council (Ref. 4-13)

TABLE 4-10
ANNUAL RISK OF EARTHQUAKES

Site	Map Area	Acceleration (g-level)							
		0.15	0.20	0.25	0.3	0.4	0.5	0.6	0.7
TEAD	5	4.0×10^{-3}	2.0×10^{-3}	1.0×10^{-3}	7.0×10^{-4}	2.6×10^{-4}	1.0×10^{-4}	4.5×10^{-5}	2.0×10^{-5}
NAAP	3	7.5×10^{-4}	3.6×10^{-4}	2.3×10^{-4}	1.3×10^{-4}	5.0×10^{-5}	2.0×10^{-5}	1.0×10^{-5}	7.0×10^{-6}
APG, ANAD, LBAD, PBA, UMDA, PUDA	2	1.5×10^{-4}	7.0×10^{-5}	4.0×10^{-5}	2.5×10^{-5}	1.2×10^{-5}	6.0×10^{-6}	3.5×10^{-6}	2.5×10^{-6}

Data obtained from Fig. 4-11.

velocity. The path of a tornado is seldom more than 10 miles long, although extreme cases are on record where the storm path extended more than 200 miles.

Meteorological and topographic conditions, which vary significantly from site to site, influence the frequency of occurrence and intensity of tornadoes. Reference 4-14 presents three regionalized maps of tornadic windspeeds corresponding to return frequencies of 1.0×10^{-7}, 1.0×10^{-6}, and 1.0×10^{-5} per year. These maps (Figs. 4-12 through 4-14) are expected to bound the intensities and return probabilities at the various sites (Ref. 4-17). A tabulation of maximum tornado windspeed and return frequency for each of the storage sites based on these figures is presented in Table 4-11.

4.2.1.2.2. <u>Tornado-Generated Missiles</u>. One of the characteristics of a tornado is its capability to generate missiles from objects lying within the strike area and from nearby structural debris. The selection of tornado-generated missiles is dependent on the intensity of the tornado, the number of potential missiles present, their position relative to the tornado path, and the physical properties of the missiles. Reference 4-18 presents a spectrum of actual wind-generated missiles. Characteristics of these missiles are listed in Table 4-12, and expected windborne missile velocities are listed in Table 4-13.

4.2.1.2.3. <u>Other Extreme Winds</u>. The approach used for the determination of extreme windspeed (other than tornado) including hurricane winds is the method suggested by Science Applications International Corporation (SAIC). SAIC (Ref. 4-15) suggested the use of a basic wind speed as defined in Ref. 4-19. A frequency of occurrence of 2.0×10^{-2} per year is associated with a basic wind speed of 70 mph. SAIC concluded that the basic wind speed was applicable to all of the sites that store M55 rockets. Lacking site-specific meteorological data, it is assumed that the basic wind speed is applicable to the other sites as well.

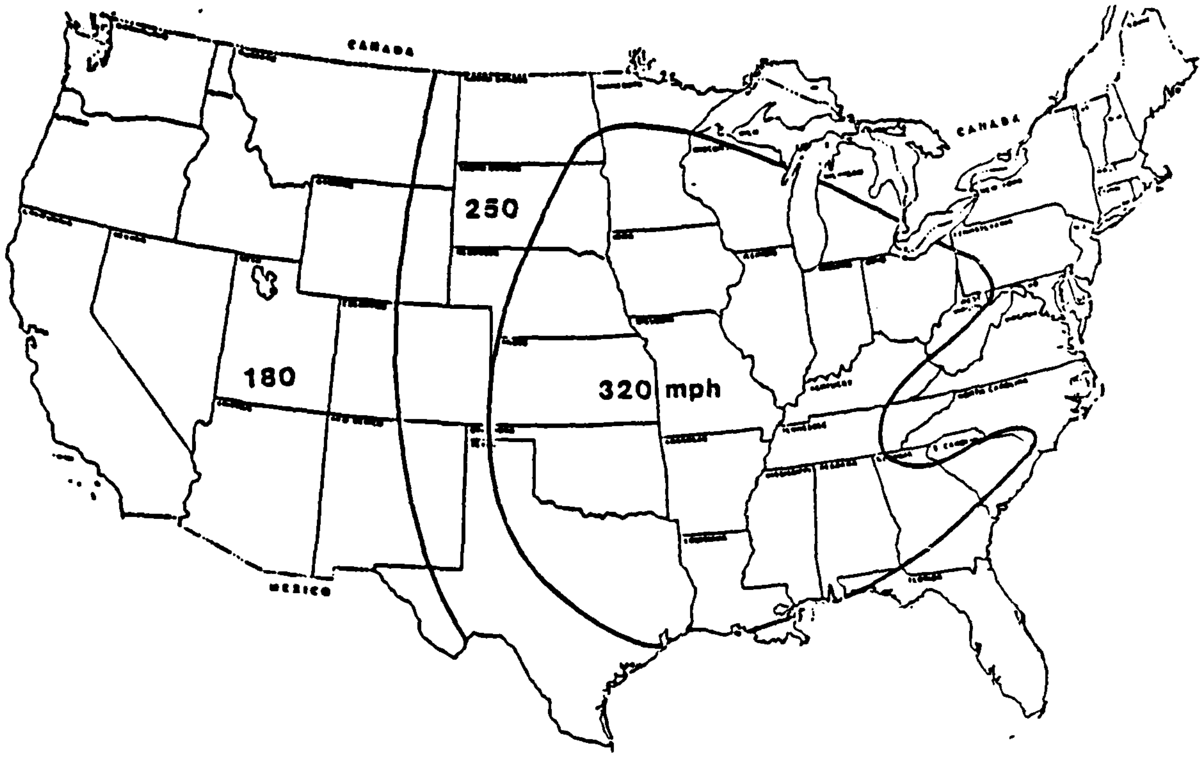


Fig. 4-12. Tornadic winds corresponding to a probability of 1.0×10^{-7} per year

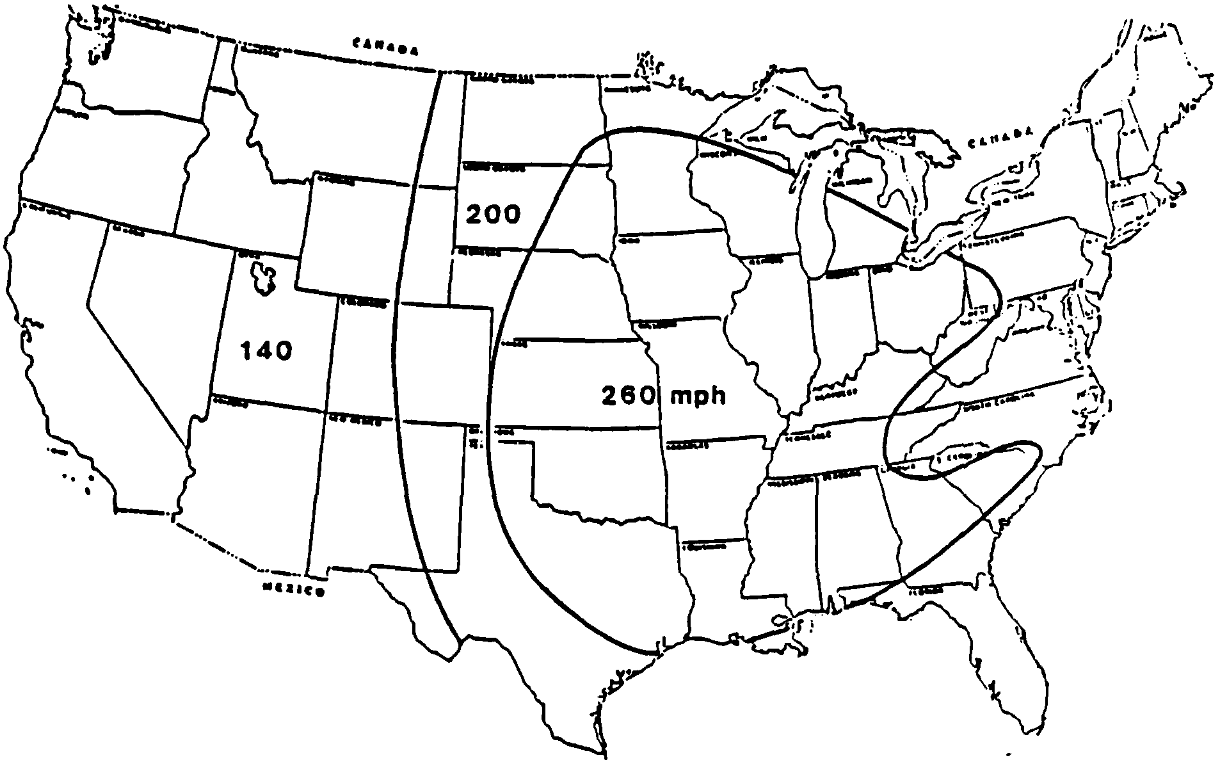


Fig. 4-13. Tornadic winds corresponding to a probability of 1.0×10^{-6} per year

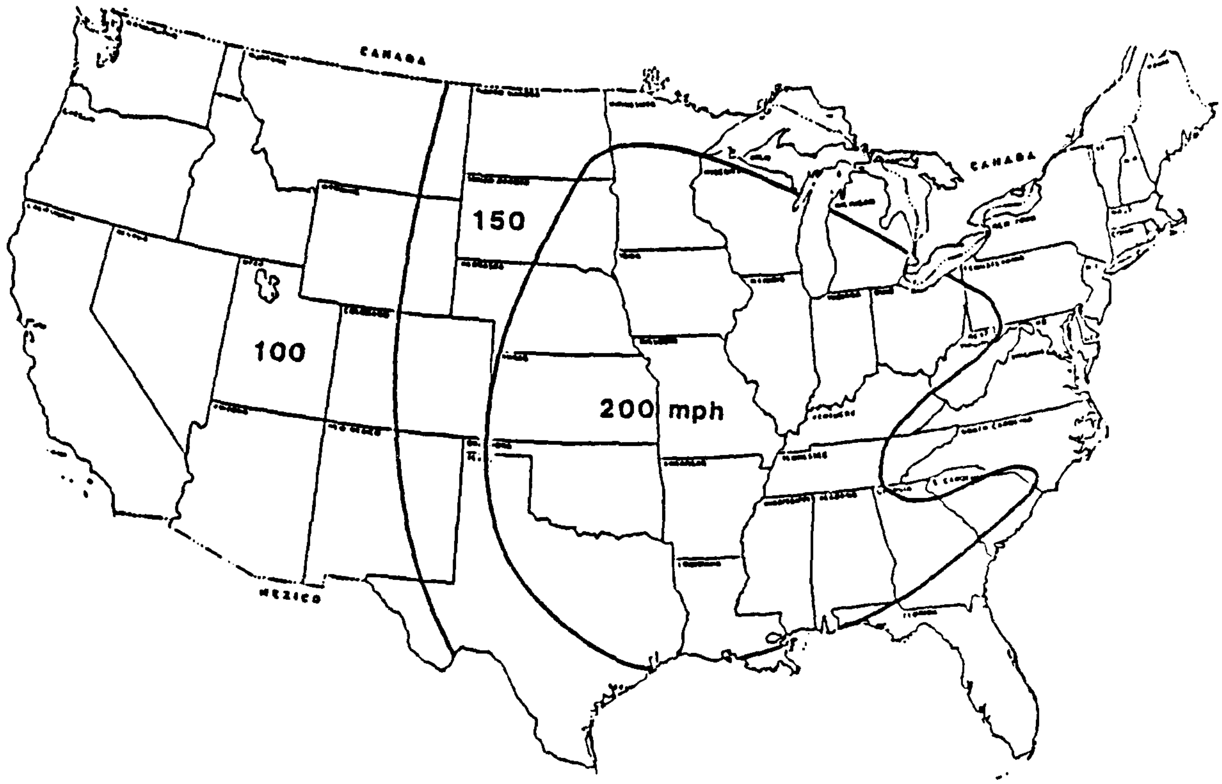


Fig. 4-14. Tornadic winds corresponding to a probability of 1.0×10^{-5} per year

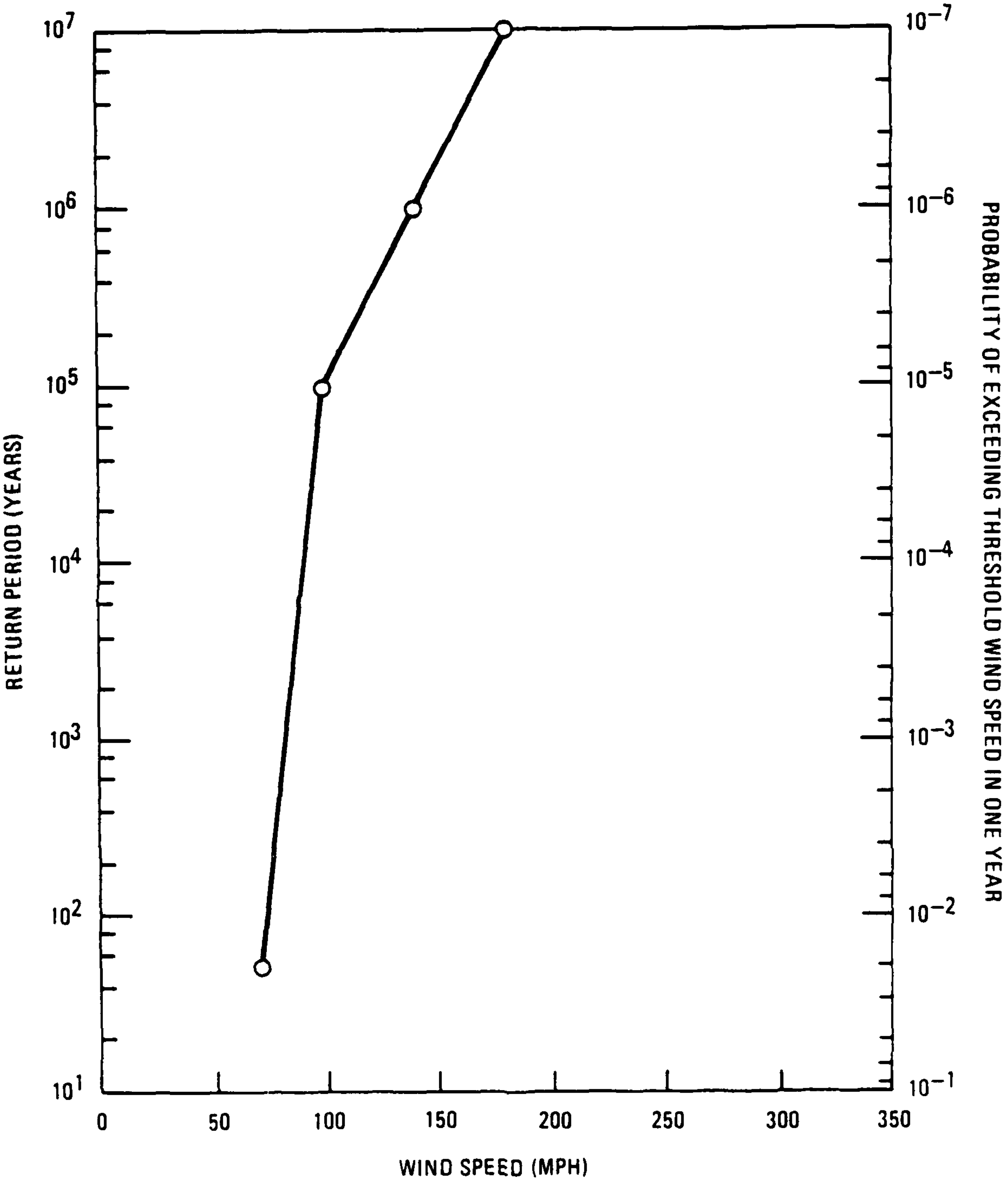


Fig. 4-15. Wind strength versus probability of recurrence, tornado Zone I (TEAD and UMDA sites)

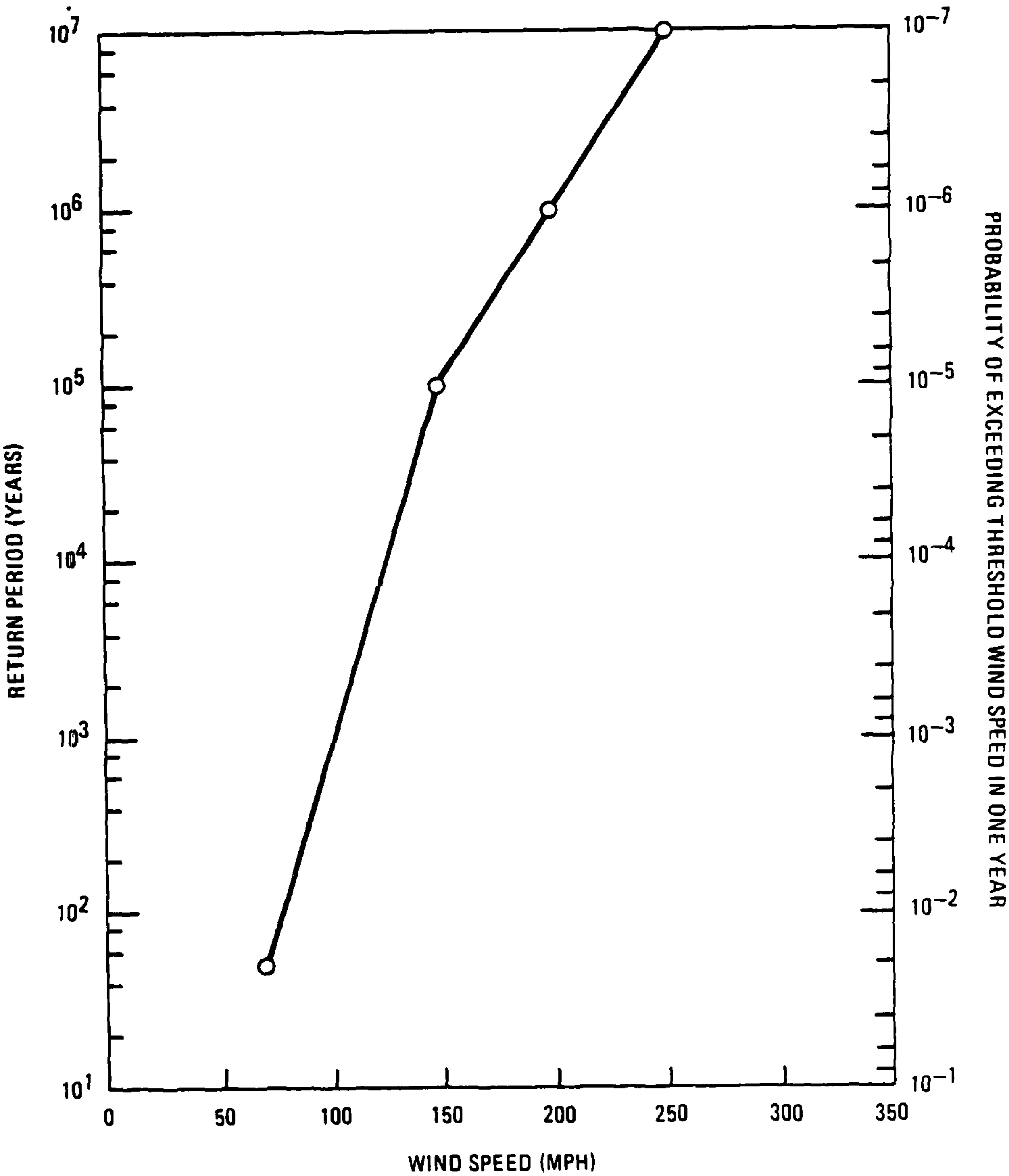


Fig. 4-16. Wind strength versus probability of recurrence, tornado Zone II (PUDA and APG sites)

TABLE 4-11
TORNADO WINDSPEEDS AND PROBABILITY OF RECURRENCE
FOR CHEMICAL STORAGE SITES

Size	Probability of Occurrence Per Year [Windspeed (mph)]		
	1.0×10^{-5}	1.0×10^{-6}	1.0×10^{-7}
ANAD (Anniston, AL)	200	260	320
LBAD (Lexington, KY)	200	260	320
UMDA (Umatilla, OR)	100	140	180
PBA (Pine Bluff, AR)	200	260	320
TEAD (Tooele, UT)	100	140	180
PUDA (Pueblo, CO)	150	200	250
NAAP (Newport, IN)	200	260	320
APG (Aberdeen, MD)	150	200	250

TABLE 4-12
WIND GENERATED MISSILE PARAMETERS[a]

Missile	Weight (lb)	Projected Area (ft^2)	Cross Sectional Area (ft^2)
Timber plank 4 in. x 12 in. x 12 ft	139	11.50	0.29
Three-in.-diameter standard steel pipe x 10 ft	75.8	2.29	0.0155[b]
Utility pole 13.5-in.-diameter x 35 ft	1490	39.4	0.99
Automobile	4000	100.0	20.0

[a]Source: Ref. 4-18.

[b]Value given is metal area. In penetration calculations the gross cross sectional area may be used.

TABLE 4-13
WINDBORNE MISSILE VELOCITIES[a]

	Horizontal Missile Velocity[b] (mph)						Maximum Height (ft)
Design Wind Speed	100	150	200	250	300	350	
Timber plank	60	72	90	100	125	175	200
Three-in.-diameter standard pipe	40	50	65	85	110	140	100
Utility pole	(c)	(c)	(c)	80	100	130	30
Automobile	(c)	(c)	(c)	25	45	70	30

[a]Source: Ref. 4-18.

[b]Vertical velocities are taken as two-thirds the horizontal missile velocity. Horizontal and vertical velocities should not be combined vectorially.

[c]Missile will not be picked up or sustained by the wind; however, for this analysis, any initial missile velocity of 80 mph or less was assigned a wind velocity of 250 mph.

In order to estimate the frequency of recurrence of winds of velocity greater than the basic wind speed, but less than the tornado wind speed, the following approach was taken. The tornado strength and frequency data, and the basic wind strength and frequency data were plotted on a scale of log probability versus wind strength. The results are shown in Figs. 4-15 through 4-17 for the three tornado regions of the U.S. as given in Ref. 4-12. A conservative approach to interpolating between the available data points is the bilinear approximation shown by the solid lines in the figures. With these figures, the probability of a given wind velocity occurring at any of the chemical storage sites can be estimated.

4.2.1.3. Aircraft Operations. Much of the data in this section were taken from the SAIC report (Ref. 1-9).

There are three major concerns in assessing potential hazards due to aircraft operations:

1. Proximity of aircraft operations to munitions areas.
2. The frequency of aircraft flights.
3. The characteristics of the aircraft traffic.

The proximity of aircraft operations to munitions activities is an important consideration in that approximately 50% of aircraft accidents which result in fatalities or destroy aircraft occur within 5 miles of airports (Ref. 1-9). Also, the close proximity of flight paths to munitions activities increases the likelihood of these areas receiving falling debris from aircraft accidents. The frequency of flight activity increases the possibility of damage to munitions by increasing the overall likelihood of an aircraft accident.

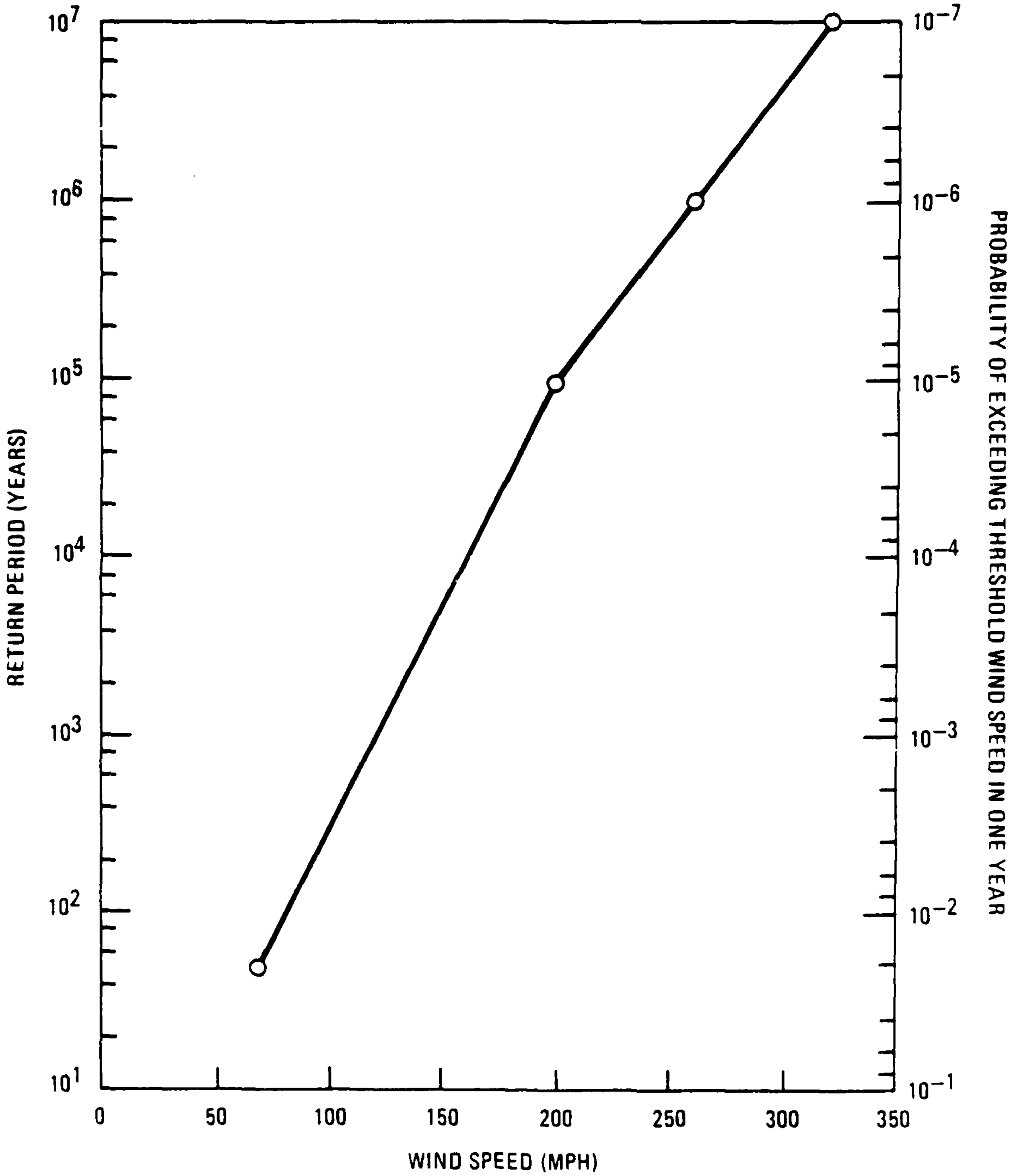


Fig. 4-17. Wind strength versus probability of recurrence, tornado Zone III (ANAD, LBAD, PGA, and NAAP sites)

Per the recommendations of NUREG-0800 (Ref. 4-16), the probability of an aircraft crash can be considered small if the distance to the site meets the following requirements:

1. The plant-to-airport distance (D) is between 5 and 10 statute miles, and the projected annual number of operations is less than 500 D^2, or the plant-to-airport distance is greater than 10 statute miles, and the projected annual number of operations is less than 1000 D^2.

2. The plant is at least 5 statute miles from the edge of military training routes, including low-level training routes, except those associated with a usage greater than 1000 flights per year, or where activities may create an unusual stress situation.

3. The plant is at least 2 statute miles beyond the nearest edge of a federal airway, holding pattern, or approach pattern.

The characteristics of an aircraft, such as its weight, number of engines, etc., are important in determining the energy of potential missiles generated in an aircraft accident, and depending on the structure they hit, the magnitude of the damage they may cause.

The frequency of an aircraft crashing while in an airway can be computed as follows (Ref. 4-16):

$$P_{FA} = C \times N \times A/W \quad , \qquad (4\text{-}1)$$

where C = inflight crash rate per mile for aircraft using airway,

W = width of airway (plus twice the distance from the airway edge to the site when the site is outside the airway) in miles,

A = effective area of facility in square miles,

N = number of flights per year along the airway.

For commercial aircraft, a value for C of 1.0×10^{-10} has been used (Ref. 4-16). For military aircraft, C is estimated to be five times the value for commercial flights (Ref. 4-13). For general aviation, C was estimated to be the same as for military aircraft.

The frequency of an aircraft crashing in the vicinity of an airport or heliport can be computed as follows (Ref. 4-16):

$$P_A = \sum_{j=1}^{L} \sum_{j=1}^{M} C_j \; N_{ij} \; A_j \quad , \qquad (4\text{-}2)$$

where L = number of flight trajectories affecting the target,

M = number of different flights using the airport,

C_j = probability per square mile of a crash per aircraft movement for j^{th} aircraft,

N_{ij} = number per year of movements by the j^{th} aircraft,

A_j = effective target area in square miles for the j^{th} aircraft.

The values for C_j which were used in the analysis are listed in Table 4-14. The total crash probability is the sum of P_{FA} and P_A. The methodology for selecting these values is discussed in Appendix C.

The Federal Aviation Administration (FAA) does not monitor the number of certain types of aircraft which fly the high and low altitude airways. Consequently, the air traffic was estimated. Since air traffic is not the same on all airways, the airways are divided into five categories with regard to air traffic: very low, low, medium, high, and very high. Table 4-15 presents estimates of the air traffic on each of these airways. Each airway was assigned to one of these categories based on the traffic expected between the cities that the airway

TABLE 4-14
AIRCRAFT CRASH PROBABILITIES NEAR AIRPORTS

Distance From End of Runway	Probability ($\times 10^8$) of a Fatal Crash per Square Mile per Aircraft Movement			
	Commercial	General Aviation	Military	Helicopters
0-1	16.7	84	7.0	168
1-2	4.0	15	1.7	30
2-3	0.96	6.2	0.72	12
3-4	0.68	3.8	0.37	7.6
4-5	0.27	1.2	0.30	2.4
5-6	0.14	0.70	0.14	1.4
6-7	0.14	0.70	0.14	1.4
7-8	0.14	0.70	0.14	1.4
8-9	0.14	0.70	0.14	1.4
9-10	0.12	0.60	0.12	1.2

TABLE 4-15
ASSUMED DISTRIBUTION OF AIR TRAFFIC[a]

Aircraft	Very Low	Low	Medium	High	Very High
			High Altitude Jet Routes		
Large commercial	1,000	2,000	5,000	10,000	20,000
Large military	500	1,000	2,500	5,000	10,000
Large general aviation	500	1,000	2,500	5,000	10,000
Total	2,000	4,000	10,000	20,000	40,000
			Low Altitude Airways		
Large commercial	400	800	2,000	4,000	8,000
Large military	240	480	1,200	2,400	4,800
Large general aviation	400	800	2,000	4,000	8,000
Small general aviation	6,960	13,920	34,800	69,600	139,200
Total	8,000	16,000	40,000	80,000	160,000

(a)Flights per year.

(b)The number of small commercial and small military flights is assumed to be small compared to other types of flights.

connects. If there are no low altitude airways near a site, it is assumed that the air traffic over the site is at least equal to that for a very low air traffic airway.

Appendix C presents tables which summarize the input data that were used to calculate the annual frequencies of both small and large aircraft crashes at each of the eight sites. The frequencies were computed using the equations given above. The annual frequencies for all the sites and for large and small aircraft and helicopters are summarized in Table 4-16. Note that for the air collocation option the annual frequencies for large aircraft crashes at APG, LBAD, and TEAD have to be adjusted by the additional flights expected into and out of these locations when munitions are moved by air from LBAD and APG to TEAD. It is expected that there will be an additiona. 1500 flights/yr at LBAD, 300 flights/yr at APG, and 1800 flights (1500 from LBAD and 300 from APG) at TEAD.

A major source of air crashes is the proximity of airports and heliports. This is of particular concern at APG, PBA, and PUDA. The air traffic for the APG analysis was supplied by POE-PM Cml Demil (Ref. 4-15). The helicopter air traffic at PBA was estimated by SAI (Ref. 4-15). The air traffic at PUDA was based on data collected at Pueblo Memorial Airport and communicated to GA by telephone. The helicopter traffic at TEAD is light and was assumed to be 15 flights per month.

The annual frequency of a crash into a specific facility is computed by multiplying the appropriate frequency taken from Table 4-16 by the effective target area of the facility (see Appendix C).

4.2.1.4. Meteorites. The frequency of meteorite strikes for meteorites 1.0 lb or greater is $4.3 \times 10^{-13}/ft^2$ (Ref. 4-20). For small meteorites (a ton or less), stone meteorites are approximately ten times more common than iron meteorites (Ref. 4-21). However, iron meteorites are more

TABLE 4-16
SUMMARY OF AIRCRAFT CRASH PROBABILITIES
(Crashes/Square-Mile/Year)

Site	Large Aircraft	Small Aircraft	Helicopters
Rail and Marine Options			
APG	5.3×10^{-7}	1.1×10^{-3}	6.7×10^{-3}
ANAD	7.9×10^{-6}	1.2×10^{-5}	N/A[(a)]
LBAD	4.5×10^{-6}	1.8×10^{-7}	N/A
NAAP	4.6×10^{-6}	2.3×10^{-5}	N/A
PBA	1.5×10^{-6}	1.8×10^{-7}	1.1×10^{-4}
PUDA	5.9×10^{-5}	1.0×10^{-4}	N/A
TEAD	3.6×10^{-7}	3.5×10^{-6}	1.1×10^{-5}
UMDA	1.5×10^{-5}	1.2×10^{-5}	N/A
Air Option			
APG	5.6×10^{-6}	1.1×10^{-3}	6.7×10^{-3}
LBAD	3.0×10^{-5}	1.8×10^{-7}	N/A
TEAD	3.1×10^{-5}	3.5×10^{-6}	1.1×10^{-5}

(a) N/A = not applicable.

dense and tend to have higher impact velocities, and consequently, represent a significant portion of the total meteorites that can rupture munitions. Table 4-17 shows the size distribution of striking meteorites for both iron and stone meteorites. The table was compiled from the data presented in Refs. 4-20 and 4-21.

4.2.2. Electromagnetic Radiation

Electromagnetic (E-M) radiation, either as a continuous source of energy or a short duration but higher energy pulse (EMP), has been considered as a potential hazard for control systems, sensitive explosive materials, and various munition components. The EMP field is a short pulse which might contain higher energies due to some uncontrollable phenomenon. Solid-state electrical circuits associated with systems which are national security sensitive are designed for protection from EMP produced electrical energies which could result from atmospheric nuclear blasts. These protection systems generally are designed as a Faraday's cage or have been designed to include "sacrificial" (i.e., expendable) electrical components. However, since nuclear warfare is out of this study's scope, the potential for these levels of energies to exist have been qualitatively screened out as not being credible as potential hazards to control systems. All munitions with the exception of M55 rockets are inherently enclosed in metal that acts as a Faraday's cage for protecting the munition's internals for normal and stray E-M fields. A Faraday's cage would provide a conducting shield for induced electrical energy which results from E-M fields passing through it. This E-M phenomenon is the basic physics principle, represented by the well-known Maxwell's equations, which enables an electrical generator to change mechanical energy to electrical energy by rotating a conducting system through a magnetic field. Therefore, with the exception of further examination of the possible effects of E-M on M55 rockets, normal or stray E-M fields have been eliminated as a potential initiating event in this hazard analysis.

TABLE 4-17
SIZE DISTRIBUTION OF METEORITES WHICH ARE 1-lb OR LARGER[a]

Weight Greater Than (lb)	Stone Meteorites[b]	Iron Meteorites[b]	All Meteorites[b]
1	0.9	0.1	1.0
2	0.3	3×10^{-2}	0.3
20	0.1	1×10^{-2}	0.1
200	3×10^{-2}	3×10^{-3}	3×10^{-2}
2,000	2×10^{-3}	2×10^{-4}	2×10^{-3}
20,000	3×10^{-4}	3×10^{-5}	3×10^{-4}

[a] Data compiled from Refs. 4-20 and 4-21.

[b] Fraction of total number of meteorites 1.0 lb or greater.

M55 rockets, and in particular the rocket motors and ignition systems, have been evaluated for their susceptibility to E-M energies or short duration pulses (EMPs in an earlier study (Ref. 4-22). M55 rockets warranted special investigation because they contain their own motors and firing systems (igniters), and because of propellant instability which could be increasing as the rockets age. The SAI M55 study (Ref. 4-22) further investigated the rocket's internals and concluded that all the critical components were contained within metallic Faraday's cage type of shields. This study screened out the "rare" event of a simultaneous failure of the igniter's shunt, which prevents electrical energies from reaching the motor, and the existence of an incident delivering sufficient electrical energy to this M55 rocket. However, if any M55 rockets have a nonworking igniter shunt, then it is not really a case of two simultaneous occurring events. There are guidelines for naval vessels (Ref. 4-23) for maximum radar and communication energies for ensuring that E-M hazards are controlled. Figures 4-18 and 4-19 are from NAVSEA HERO document (Ref. 4-23) and represent the safe field strength and power densities for fully assembled ordnance. These curves are based on experimental results of HERO tests. The boundaries were established by the most susceptible ordnance items. We recommend that further effort be expended in determining whether or not the most sensitive ordnance onboard the naval vessels include items similar to the M55 rockets and in determining what the field strength and power density boundaries mean terms of radio or radar transmission energies which can be more easily understood and enforced.

In summary, E-M and EMP have been screened out as potential sources for plant operations' initiating events; however, further analysis and study are recommended to administratively control the safe demilitarization of munitions well within the safe E-M boundaries.

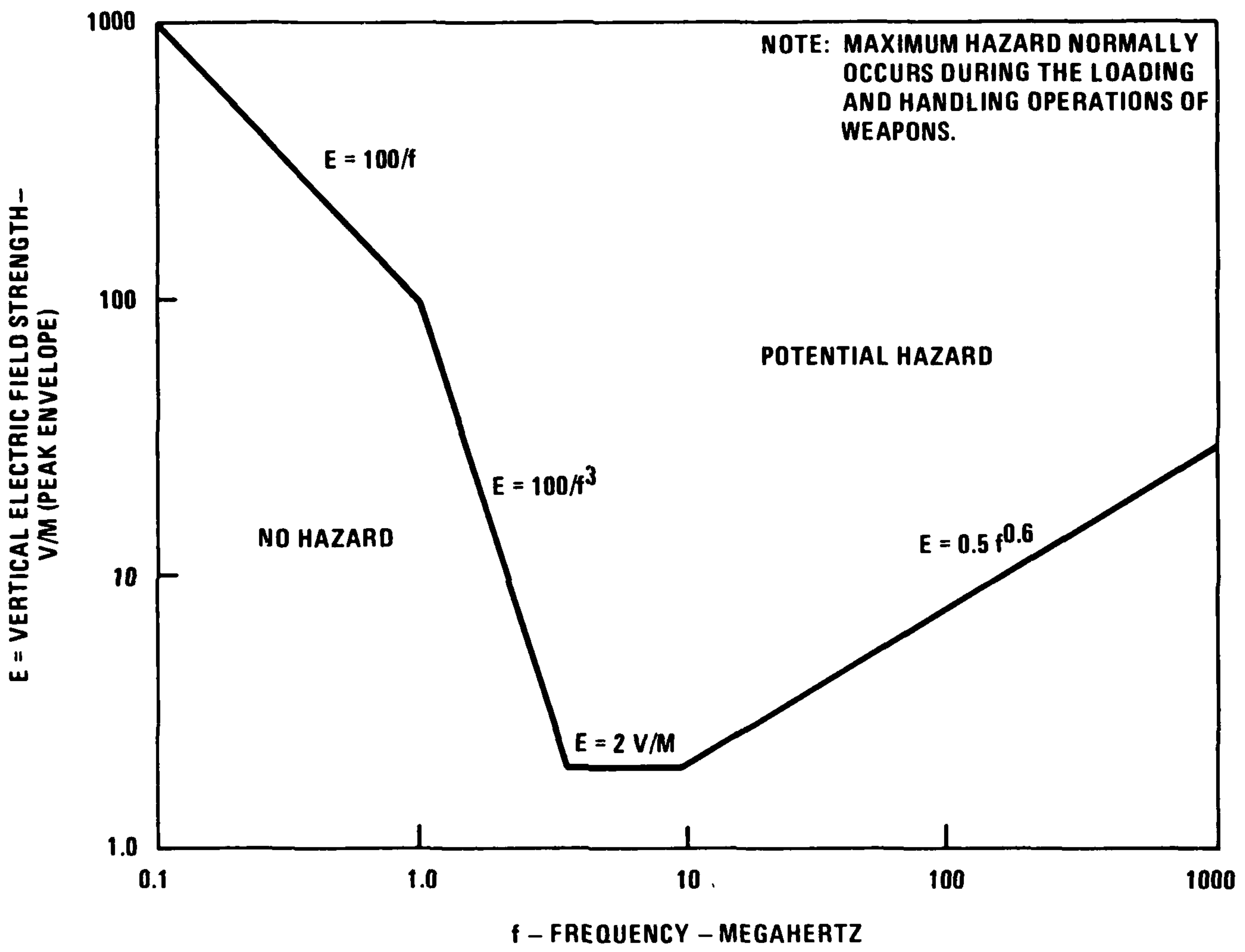


Fig. 4-18. Field intensity potentially hazardous to susceptible weapons which require special restriction - communication frequencies

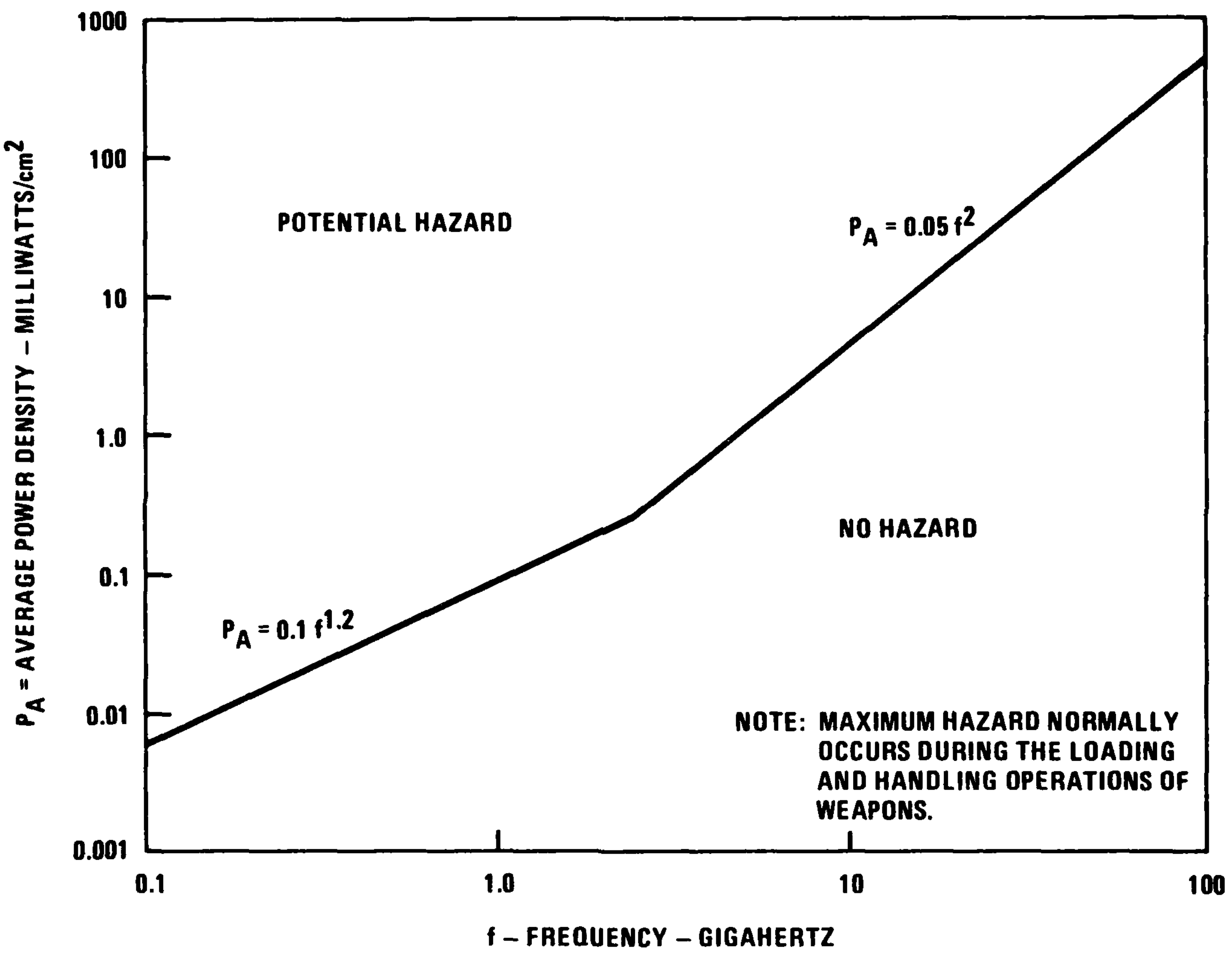


Fig. 4-19. Field intensity potentially hazardous to susceptible weapons which require special restrictions - radar frequencies

4.2.3. Internal Events

Table 4-18 summarizes the internal initiating events for all demilitarization phases of the collocation disposal option. Also summarized in the table are the event occurrence frequencies. The bases for these frequencies are discussed in the individual phase sections dealing with the event tree analysis, Sections 5 through 8, and are not repeated here.

TABLE 4-18
LIST OF INTERNAL INITIATING EVENTS AND FREQUENCIES

Event	Frequency — Clothing Level A	C	F
STORAGE/HANDLING EVENTS (per operation)			
1. Munition drop from CHE (bulk containers)	3×10^{-5}	1.5×10^{-6}	3×10^{-6}
2. Munition drop from forklift (pallets or ST in overpacks)	3×10^{-4}	1.5×10^{-5}	3×10^{-5}
3. Munition drop from hand (single units)	6×10^{-4}	3×10^{-4}	6×10^{-5}
4. Forklift tine accident	1×10^{-4}	5×10^{-5}	1×10^{-5}
5. Forklift or CHE collision	4.3×10^{-6}	4.3×10^{-6}	4.3×10^{-6}
6. Leak between inspections (stored pallets)	Munition dependent		
7. Leak in ONC or OFC; failure to detect	Munition dependent		

Events	Frequency
TRANSPORT EVENTS	
1. Truck collision or overturn in convoy	1.4×10^{-7}/road mile
2. Truck fire in convoy	2.8×10^{-8}/road mile
3. Train derailment (human error or equipment failure)	5.5×10^{-6}/road mile
4. Aircraft crash at APG	4.2×10^{-7}/yr
5. Aircraft crash at LBAD	1.6×10^{-9}/yr
6. Aircraft crash at TEAD	9.1×10^{-10}/yr

TABLE 4-18 (Continued)

Events	Frequency
7. Barge collision	5.0×10^{-5}/shipment
8. Barge ramming	4.1×10^{-5}/shipment
9. Barge grounding	8.6×10^{-5}/shipment
10. LASH collision, inland	1.8×10^{-4}/shipment
LASH collision, coastal	8.1×10^{-5}/shipment
LASH collision, sea	1.8×10^{-5}/shipment
11. LASH ramming, inland	2.5×10^{-5}/shipment
LASH ramming, coastal	1.7×10^{-5}/shipment
LASH ramming, sea	1.3×10^{-5}/shipment
12. LASH grounding, inland	2.3×10^{-4}/shipment
LASH grounding, coastal	6.6×10^{-5}/shipment
LASH grounding, sea	5.5×10^{-6}/shipment

PLANT OPERATIONS EVENTS

1. Munition spill in ECV	K: 4×10^{-5}/yr
	R: 3×10^{-7}/yr
	M: 4×10^{-7}/yr
	Q: 3×10^{-7}/yr
	C: 1×10^{-8}/yr
	P: 6×10^{-7}/yr
2. Munition(s) spill in ECR	1M: 10^{-1}/yr
	2M: 10^{-2}/yr
	1Q: 10^{-1}/yr
	2Q: 10^{-2}/yr
	1R: 10^{-2}/yr
	2R: 10^{-3}/yr
3. Munition detonates in ECR	M: 4×10^{-4}/yr
	R: 1×10^{-2}/yr
	others: 2×10^{-3}/yr
4. Munition(s) spill in MPB	K: 4×10^{-5}/yr
	Q: 3×10^{-3}/yr
	2Q: 3×10^{-4}/yr
5. Ton container spill in BSA	4×10^{-5}/yr
6. Small TOX spill	1×10^{-3}/yr

TABLE 4-18 (Continued)

Events	Frequency
7. Large TOX spill	1×10^{-3}/yr
8. Unpunched bulk item fed to MPF	KH: 1×10^{-9}/yr KV: 6×10^{-1}/yr KG: 9.2×10^{-10}/yr B: 6.4×10^{-9}/yr S: 7.2×10^{-10}/yr

4.3. REFERENCES

4-1. "PRA Procedures Guide," Nuclear Regulatory Commission, NUREG/CR-2300, 1982.

4-2. Fraize, W., et al., "Preliminary Risk Analysis Supporting the Chemical Weapons Stockpile Disposal Program (CSDP)," Volume 1: Analysis (MTR-86W4-01) and Volume 2: Appendices (MTR-86W4-02), the MITRE Corporation, May 1987.

4-3. Arthur D. Little, Inc., "Analysis of Risks Associated with Operation on Onsite M55 Rocket Demilitarization Plants," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-3, May 1985.

4-4. Arthur D. Little, Inc., "Analysis of Risks Associated with Operation of the JACADS M55 Rocket Demilitarization Plant," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-9, May 1985.

4-5. Arthur D. Little, Inc., "Analysis of Converted M55 Rocket Demilitarization Plant at Pine Bluff Arsenal," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-10, May 1985.

4-6. Arthur D. Little, Inc., "Analysis of Risks Associated with Operation of the CAMDS M55 Rocket Demilitarization Plant," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-11, May 1985.

4-7. Arthur D. Little, Inc., "M55 Rocket Separation Study," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-08, November 1985.

4-8. The Ralph M. Parsons Company, "JACADS-Preliminary Hazards Analysis of Final Concept Design," Task G-56 Interim Report, May 1983.

4-9. The Ralph M. Parsons Company, "Fault Tree Analysis, Johnston Atoll Chemical Agent Disposal System," Task G-SC, U.S. Army Engineers Division, February 1985.

4-10. Rhyne, W. R., et al., "Probabilistic Analysis of Chemical Agent Release During Transport of M55 Rockets," H&R Technical Associates, Inc., Prepared for USATHAMA, M55-OD-4, H&R 255-1, September 1985.

4-11. Uniform Building Code, International Conference of Building Officials, 1985.

4-12. "Technical Manual, Seismic Design for Buildings," TM 5-809-10, Department of the Army, the Navy, and the Air Force, February 1982.

4-13. "Tentative Provisions for the Development of the Seismic Regulations for Buildings," Applied Technology Council, ATC 3-06, NBS SP-510, NSF 78-8, June 1978.

4-14. "Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites," ANSI/ANS-2.3-1983, 1983.

4-15. Science Applications International Corporation, "Probabilities of Selected Hazards in Disposition of M55 Rockets," U.S. Army Toxic and Hazardous Materials Agency, M55-CS-2, November 1985.

4-16. "USNRC Standard Review Plan," Section 3.5.1.6, "Aircraft Hazards," U.S. Nuclear Regulatory Commission, NUREG-0800, July 1981.

4-17. Memo from OPMCM to GA Technologies Inc., November 20, 1986.

4-18. Coats, D. W., "Natural Phenomena Hazards Modeling Project: Extreme Wind/Tornado Hazards Model for Department of Energy Sites," UCRL-53526, Lawrence Livermore National Laboratory, February 1984.

4-19. "Minimum Design Loads for Buildings and Structures," American National Standards Institute, ANSI A58.1-1982.

4-20. Solomon, K. A., K. C. Erdmann, and D. Okrent, "Estimate of the Hazards to a Nuclear Reactor from the Random Impact of Meteorites," Nuclear Technology, Vol. 25, January 1975.

4-21. Blake, V. E., "A Prediction of the Hazards from the Random Impact of Meteorites on the Earth's Surface," Sandia Laboratories SC-RR-68-838, December 1968.

4-22. Science Applications International Corporation, "Probabilities of Selected Hazards in Disposition of M55 Rockets," U.S. Army Toxic and Hazardous Materials Agency, M55-CS-2, November 1985.

4-23. NAVSEA OD 30393, Design Principles and Practices for Controlling Hazards of Electromagnetic Rariation to Ordnance (Hero Design Guide), First Edition.

5. SCENARIO LOGIC MODELS FOR STORAGE

5.1. SEQUENCE LIST AND EVENT TREES

The accident scenarios involving the interim storage of chemical munitions were categorized as follows:

1. External event-induced agent releases (e.g., earthquakes, aircraft crashes, etc.).

2. Releases due to leakage of munitions while in storage.

3. Releases from accidents that could occur during the isolation of leaking munitions while in storage.

For the collocation option, interim storage encompasses several phases: (1) storage of munitions at their original location (in igloos, warehouses, or open yards) before transfer to a destruction center; (2) storage of munitions in offsite transportation containers at the holding area of a sending site while awaiting loading onto a train car, aircraft, or barge; (3) storage of munitions in offsite transportation containers in the holding area of a receiving site upon arrival and while awaiting movement to a storage location; and (4) storage of the unpackaged munitions at this storage location before movement to a demil facility.

As discussed in Section 3, there are three transport modes discussed in this report. The rail transport mode applies to all sending sites; the air option applies only to movement of munitions from APG and LBAD to TEAD; and the marine option applies only to movement of

munitions from APG to Johnston Atoll. The storage analysis considers not only the existing storage locations but also interim storage at the disposal site and storage at the holding areas of the sending and disposal sites.

There are three types of transportation packages addressed here. For the rail and air options, the offsite transportation container consists of 90-in. diameter by 18-ft long inner container, and 8 x 8 x 20 ft steel outer container. For the marine option, the offsite container is a 106 x 44 x 54 in. steel vault designed to provide protection from impact, crush, puncture, and fire. To distinguish between the two containers, the offsite transport container for rail and air is referred to as an OFC, and the one for marine as the vault. Details on the OFC and vault are provided in Section 3.3 and Appendix F. For onsite transport from interim storage to the demil facility at the disposal site, an onsite transport container (ONC) is used. Table 3-3 gives dimensions and failure criteria for all three packages.

Table 5-1 presents the list of accident sequences identified and evaluated for the continued storage option. Accident sequences involving munitions in offsite transportation containers are designated SR, SA, SW for rail, air, and marine options, respectively. The event tree models are shown in Figs. 5-1 through 5-10. They will be discussed in the following sections by initiating event category. In these event trees, the following notations are used:

NR = no release of agent
F = sequence screened based on low frequency criterion
C = sequence screened based on low release criterion.

TABLE 5-1
MASTER LIST OF STORAGE ACCIDENTS

Event ID	Description
SL1	Munition develops a leak between inspections.
SL2	Munition punctured by forklift tine during leaker-handling activities.
SL3	Spontaneous ignition of rocket during storage[a]
SL4	Large aircraft direct crash onto storage area; fire not contained in 30 min. (Note: Assume detonation occurs if burstered munitions hit; fire involving burstered munitions not contained at all.)
SL5	Large aircraft indirect crash onto storage area; fire not contained in 30 min. (See note in SL4.)
SL6	Tornado-generated missiles strike the storage magazine, warehouse, or open storage area; munitions breached (no detonation).
SL7	Severe earthquake breaches the munitions in storage igloos; no detonations.
SL8	Meteorite strikes the storage area; fire occurs; munitions breached (if burstered, detonation also occurs).
SL9	Munition dropped during leaker isolation operation; munition punctured.
SL10	Storage igloo or warehouse fire from internal sources.[a]
SL11	Munitions are dropped due to pallet degradation.[a]
SL12	Liquid propane gas (LPG) infiltrates igloo/building.[a]
SL13	Flammable liquids stored in nearby facilities explode; fire propagates to munition warehouse (applies to NAAP).[a]
SL14	Tornado-induced building collapse leads to breaching/ detonation of munitions.[a]
SL15	Small aircraft direct crash onto warehouse or open storage yard; fire occurs; not contained in 30 min.

[a] Screened out for the reasons stated in Table 5-2.

TABLE 5-1 (Continued)

Event ID	Description
SL16	Large aircraft direct crash; no fire; detonation (if burstered).
SL17	Large aircraft direct crash; fire contained within 30 min (applies to nonburstered munitions only).
SL18	Small aircraft direct crash onto warehouse or open storage yard; no fire.
SL19	Small aircraft direct crash onto warehouse or open storage yard; fire contained in 30 min.
SL20	Large aircraft indirect crash onto storage area; no fire.
SL21	Large aircraft indirect crash onto storage area; fire contained in 30 min.
SL22	Severe earthquake leads to munition detonation.
SL23	Tornado-generated missiles strike the storage igloo and leads to munition detonation.
SL24	Lightning strikes ton containers stored outdoors.
SL25	Munition dropped during leaker isolation; munition detonates.
SL261	Earthquake occurs; NAAP warehouse is intact; no ton containers damaged; fire occurs.
SL262	Earthquake occurs; NAAP warehouse is intact; ton container damaged; no fire.
S1263	Earthquake occurs; NAAP warehouse is intact; ton container damaged; fire occurs.
SL264	Earthquake occurs; NAAP warehouse is damaged; ton containers damaged; no fire.
SL265	Earthquake occurs; NAAP warehouse is damaged; ton containers damaged; fire occurs.
SL271	Earthquake occurs; TEAD warehouses intact; munitions intact; fire occurs at one warehouse.
SL272	Earthquake occurs; TEAD warehouses intact; munitions intact; fire occurs at two warehouses.

TABLE 5-1 (Continued)

Event ID	Description
SL273	Earthquake occurs; one TEAD warehouse is damaged; munitions intact; fire occurs at one warehouse.
SL274	Earthquake occurs; one TEAD warehouse is damaged; munitions intact; fire occurs at two warehouses.
SL275	Earthquake occurs; two TEAD warehouses damaged; munitions intact; fire occurs at one warehouse.
SL276	Earthquake occurs; two TEAD warehouses damaged; munitions intact; fire occurs at two warehouses.
SL281	Earthquake occurs; UMDA warehouses intact; munitions intact; fire occurs at one warehouse.
SL282	Earthquake occurs; UMDA warehouses intact; munitions intact; fire occurs at two warehouses.
SL283	Earthquake occurs; UMDA warehouses intact; munitions in one warehouse damaged; no fire occurs.
SL284	Earthquake occurs; UMDA warehouses intact; munitions in one warehouse damaged; fire occurs at warehouse with damaged munitions.
SL285	Earthquake occurs; UMDA warehouses intact; munitions in one warehouse damaged; fire occurs at warehouse with undamaged munitions.
SL286	Earthquake occurs; UMDA warehouses intact; munitions in one warehouse damaged; fire occurs at two warehouses.
SL287	Earthquake occurs; UMDA warehouses intact; munitions in two warehouses damaged; no fire occurs.
SL288	Earthquake occurs; UMDA warehouses intact; munitions in two warehouses damaged; fire occurs at warehouse with damaged munitions.
SL289	Earthquake occurs; UMDA warehouses intact; munitions in two warehouses damaged; fire occurs at two warehouses.
SL2810	Earthquake occurs; one UMDA warehouse damaged; munitions in one warehouse damaged; no fire occurs.

TABLE 5-1 (Continued)

Event ID	Description
SL2811	Earthquake occurs; one UMDA warehouse damaged; munitions in one warehouse damaged; fire occurs at warehouse with damaged munitions.
SL2812	Earthquake occurs; one UMDA warehouse damaged; munitions in one warehouse damaged; fire occurs at two warehouses.
SL2813	Earthquake occurs; one UMDA warehouse damaged; munitions in two warehouses damaged; no fire occurs.
SL2814	Earthquake occurs; one UMDA warehouse damaged; munitions in two warehouses damaged; fire occurs warehouse with damaged munitions.
SL2815	Earthquake occurs; one UMDA warehouse damaged; munitions in two warehouses damaged; fire occurs at two warehouses.
SL2816	Earthquake occurs; two UMDA warehouses damaged; munitions in two warehouses damaged; no fire occurs.
SL2817	Earthquake occurs; two UMDA warehouses damaged; munitions in two warehouses damaged; fire occurs at both warehouses.
<u>Rail Option</u>	
SR1	Large aircraft direct crash onto transportation containers in holding area; no fire.
SR2	Large aircraft direct crash onto transportation containers in holding area; fire occurs but not contained.
SR3	Large aircraft direct crash onto transportation containers in holding area; fire contained but agent spill is burned.
SR4	Small aircraft direct crash onto transportation containers in holding area; no fire.
SR5	Small aircraft direct crash onto transportation containers in holding area; fire not contained.
SR6	Small aircraft direct crash onto transportation containers in holding area; fire contained.
SR7	Tornado-generated missiles strike munitions in transportation containers in holding area; no detonation.

TABLE 5-1 (Continued)

Event ID	Description
SR8	Tornado-generated missiles strike munitions in holding area; detonation occurs.
SR9	Meteorite strikes munitions in transportation containers in holding area; fire occurs; detonation (if burstered).
<u>Air Option</u>	
SA1	Large aircraft direct crash onto transportation containers in holding area; no fire.
SA2	Large aircraft direct crash onto transportation containers in holding area; fire not contained.
SA3	Large aircraft direct crash onto transportation containers in holding area; fire contained.
SA4	Small aircraft direct crash onto transportation containers in holding area; no fire.
SA5	Small aircraft direct crash onto transportation containers in holding area; fire not contained.
SA6	Small aircraft direct crash onto transportation containers in holding area; fire contained.
SA7	Tornado-generated missiles strike munitions in transportation containers in holding area; no detonation.
SA8	Tornado-generated missiles strike munitions in holding area; detonation occurs.
SA9	Meteorite strikes munitions in transportation containers in holding area; fire occurs; detonation (if burstered).
<u>Marine Option</u>	
SW1	Large aircraft direct crash onto transportation containers in holding area; no fire.
SW2	Large aircraft direct crash onto transportation containers in holding area; fire not contained.
SW3	Large aircraft direct crash onto transportation containers in holding area; fire contained.

TABLE 5-1 (Continued)

Event ID	Description
SW4	Small aircraft direct crash onto transportation containers in holding area; no fire.
SW5	Small aircraft direct crash onto transportation containers in holding area; fire not contained.
SW6	Small aircraft direct crash onto transportation containers in holding area; fire contained.
SW7	Tornado-generated missiles strike munitions in transportation containers in holding area; no detonation.
SW9	Meteorite strikes munitions in transportation containers in holding area; fire occurs.

TABLE 5-2
ACCIDENT SEQUENCES ELIMINATED FROM DETAILED ANALYSIS

Accident Sequence	Description	Basis for Elimination
1. SL3	Spontaneous ignition of rocket during storage.	Recent study indicates that the propellant is stable and will continue to be so for some time (Ref. 5-18). There is an enhanced monitoring program to sample propellant in storage. There are also accelerated tests being performed to provide advanced warning of the onset of propellant destabilization.
2. SL11	Munitions are dropped and damaged due to pallet degradation.	The pallets in storage are in very good condition and are expected to remain so for many more years. The munitions are periodically inspected, and if deterioration is observed, the causes are identified and corrected, and the degraded pallet replaced.
3. SL10	Storage igloo or building fire from internal sources.	There is no source of fire in the storage igloos or storage buildings (Ref. 5-1).
4. SL12	Liquid propane gas (LPG) infiltrates igloo/building.	LPG cloud due to release of largest conceivable inventory (35,000 gal) cannot deposit flammable concentration inside the igloo or building (Ref. 5-1).
5. SL13	Flammable liquids stored in nearby facilities explode; fire propagates to munition warehouse (applies to NAAP only).	Several empty storage vessels are located approximately 350 ft from the nearest ton containers outside the exclusion area at NAAP. These tanks were used in conjunction with the former VX production facility. It

TABLE 5-2 (Continued)

Accident Sequence	Description	Basis for Elimination
		is the Army's position to ensure that these tanks will remain empty while munitions are being stored at the NAAP warehouse.
6. (a)	Tornado-induced munition drop leads to munition ignition and detonation.	Calculations indicate that tornado winds at 200 mph will not lift munitions (Ref. 5-2).
7. (a)	Tornado winds lift ton containers and drop them to the ground; container ruptures.	Same as item 6.
8. (a)	A vehicle fire spreads to the storage area/igloo and sets off munitions	Previous analysis indicated that even if the fire was just outside the igloo and the igloo door was open, the munition thermal failure threshold will not be exceeded (Ref. 5-1).
9. (a)	Electrostatic ignition of rocket motor leads to detonation and fire.	Previous study indicated there was no source of spark capable of igniting a rocket motor accidentally (Ref. 5-1).
10. (a)	Electromagnetic pulse (EMP) effects cause detonation.	Previous study concluded there were no sources of EMP of sufficient strength to cause damage to the munitions (Ref. 5-1).

(a) Sequence number not identified in GA's list.

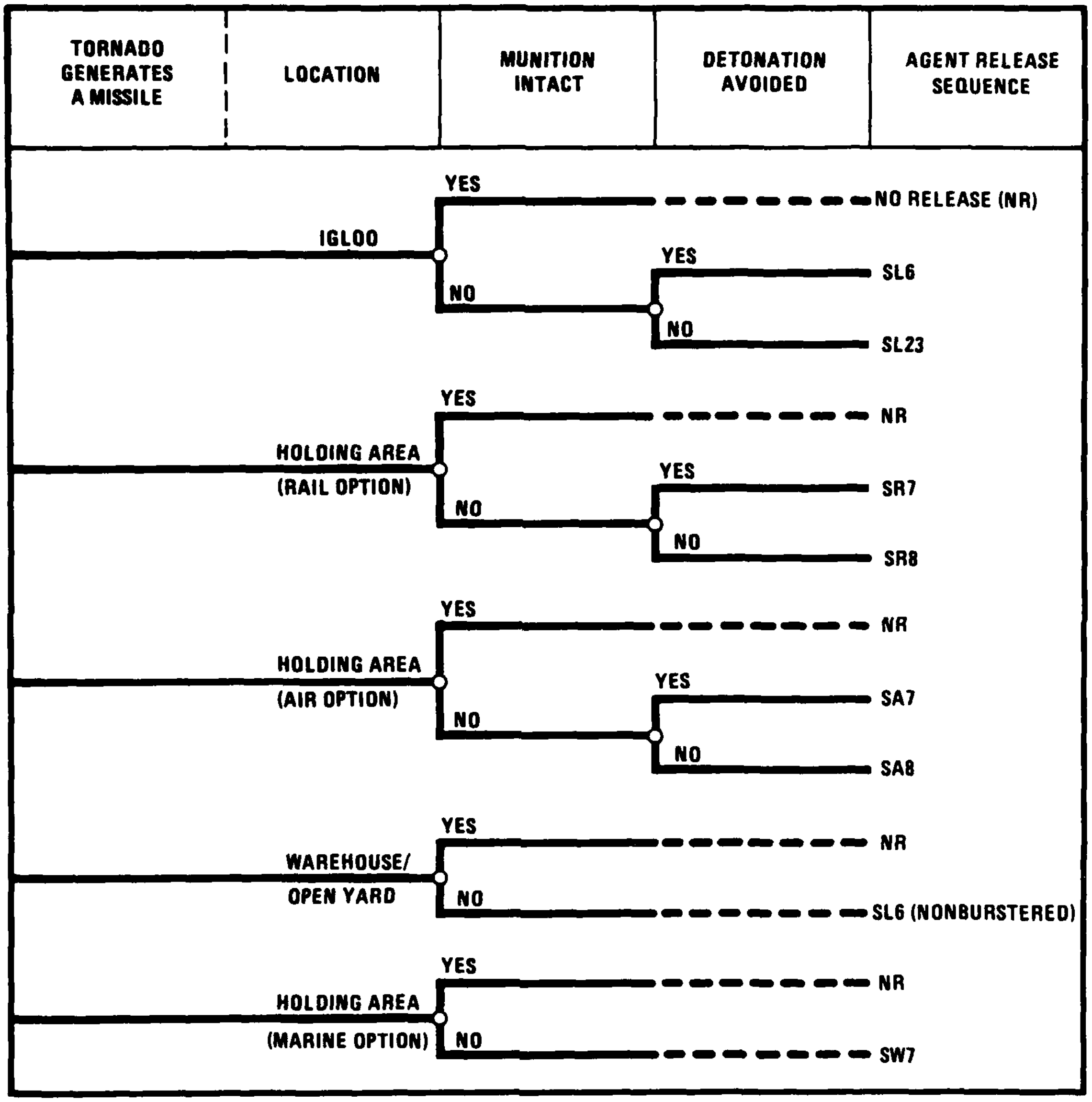


Fig. 5-1. Agent release indicated by tornado-generated missiles

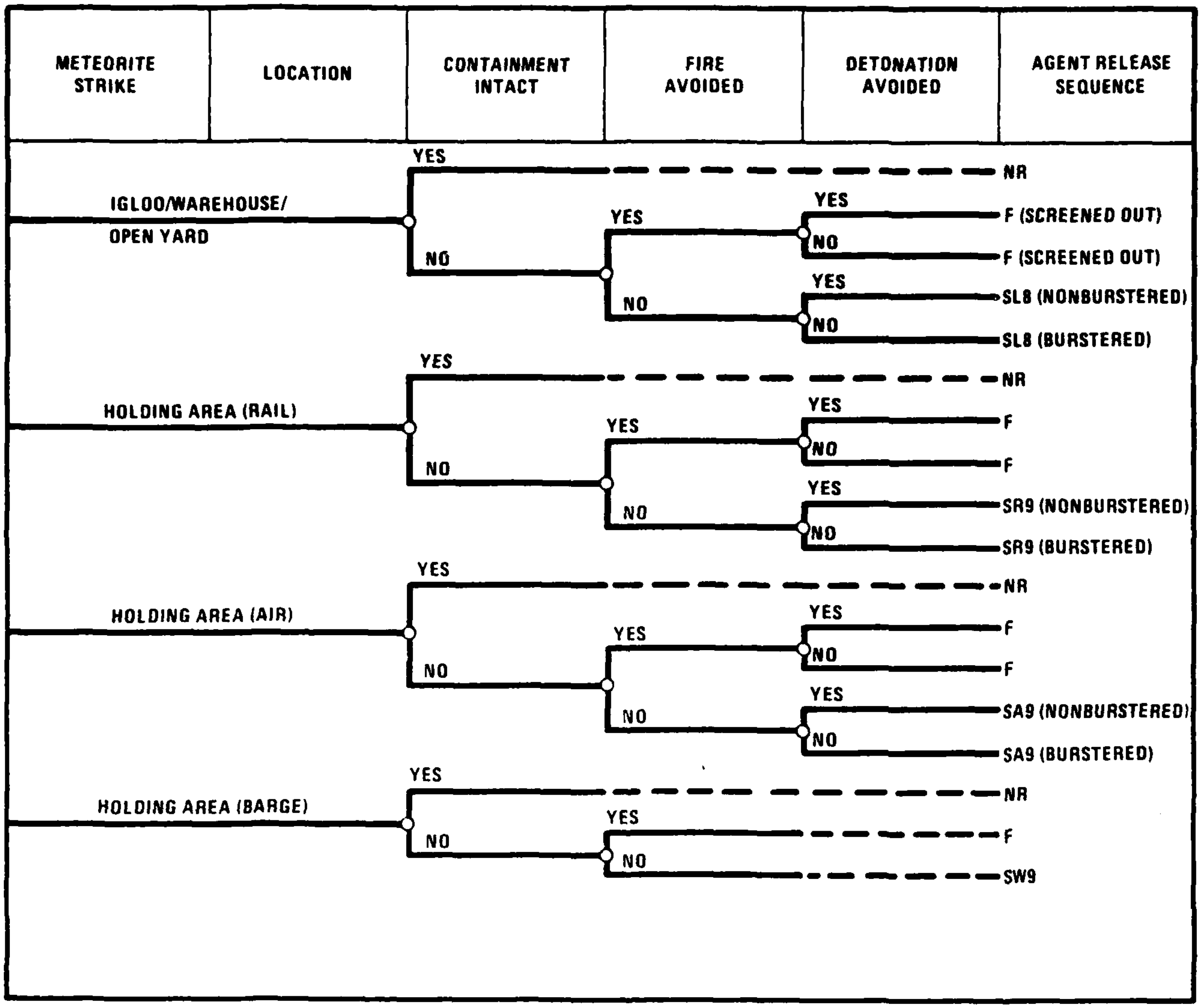


Fig. 5-2. Meteorite-induced agent release

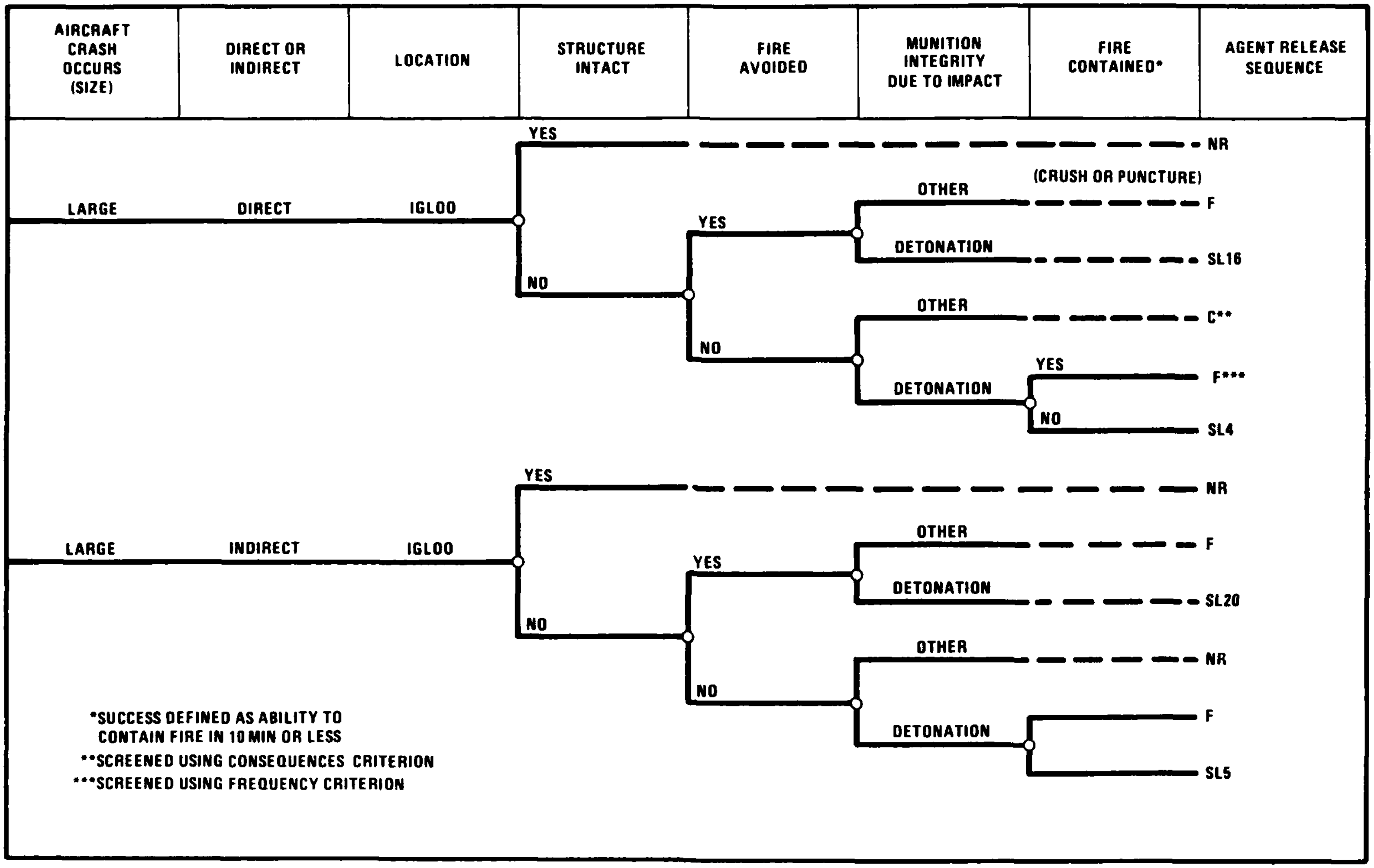


Fig. 5-3. Large aircraft crash onto storage igloos containing burstered munitions

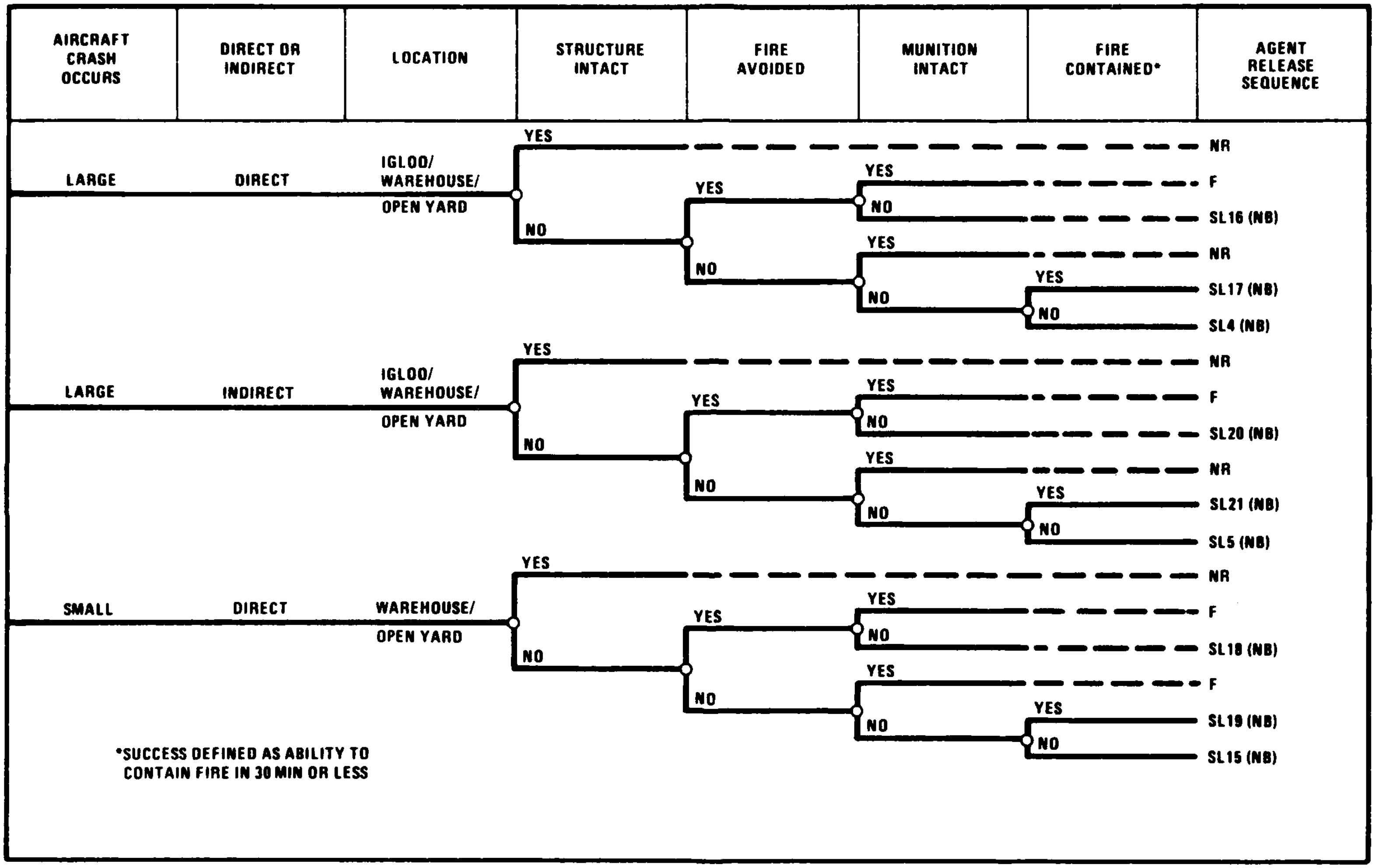


Fig. 5-4. Aircraft crash onto storage facilities with nonburstered (NB) munitions

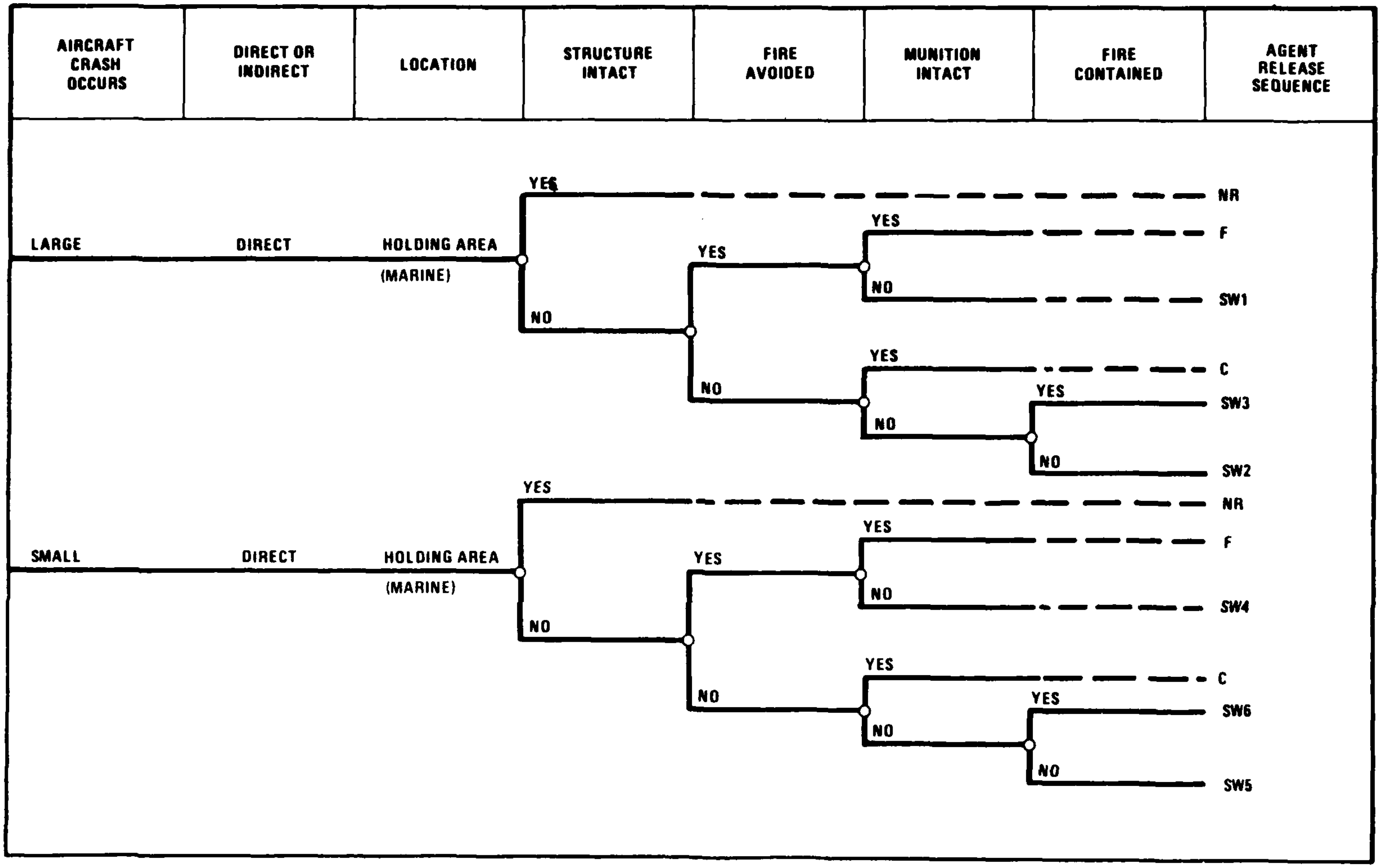


Fig. 5-5. Aircraft crash accidents involving munitions in holding area (marine option)

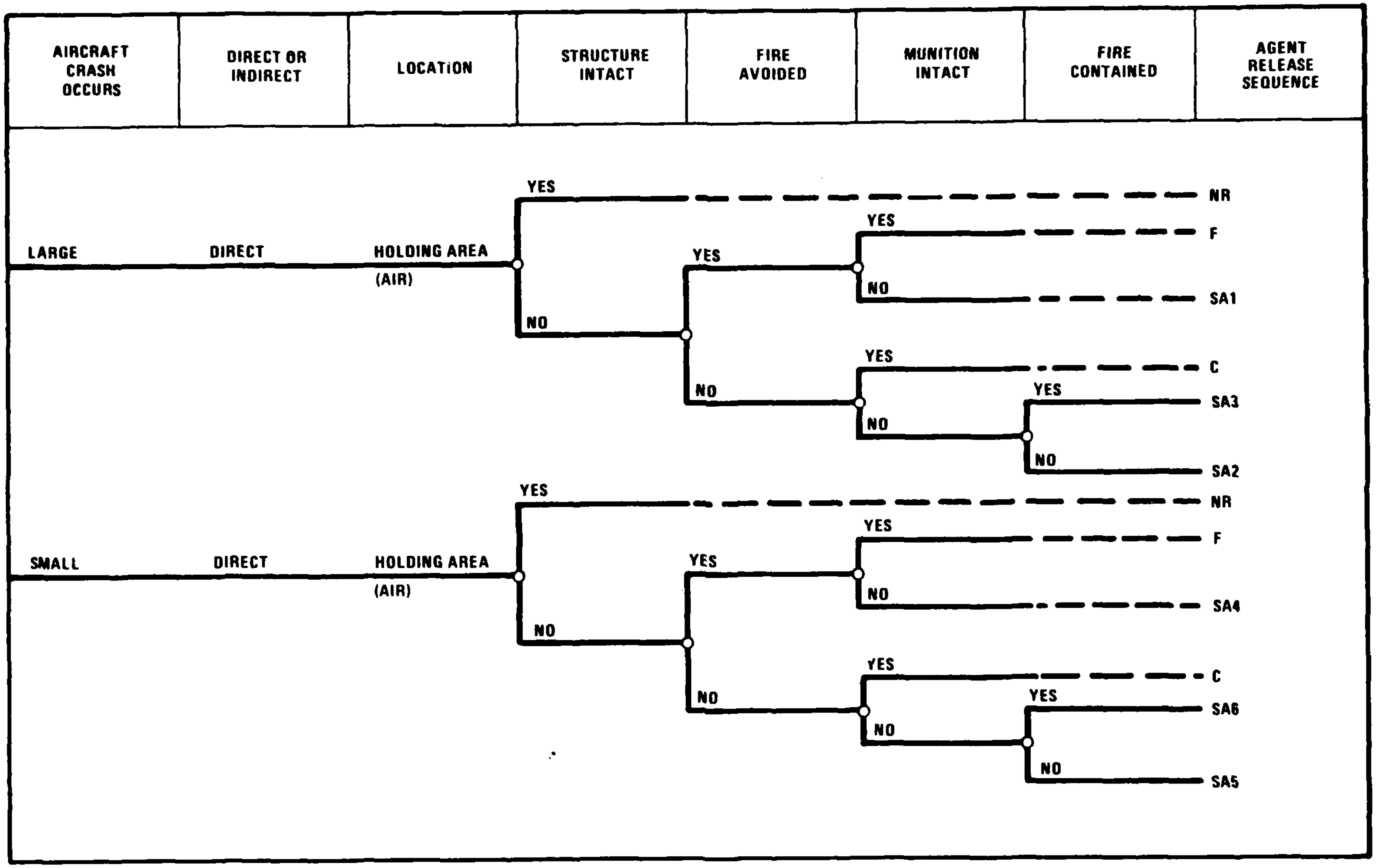


Fig. 5-6. Aircraft crash accidents involving munitions in holding area (air option)

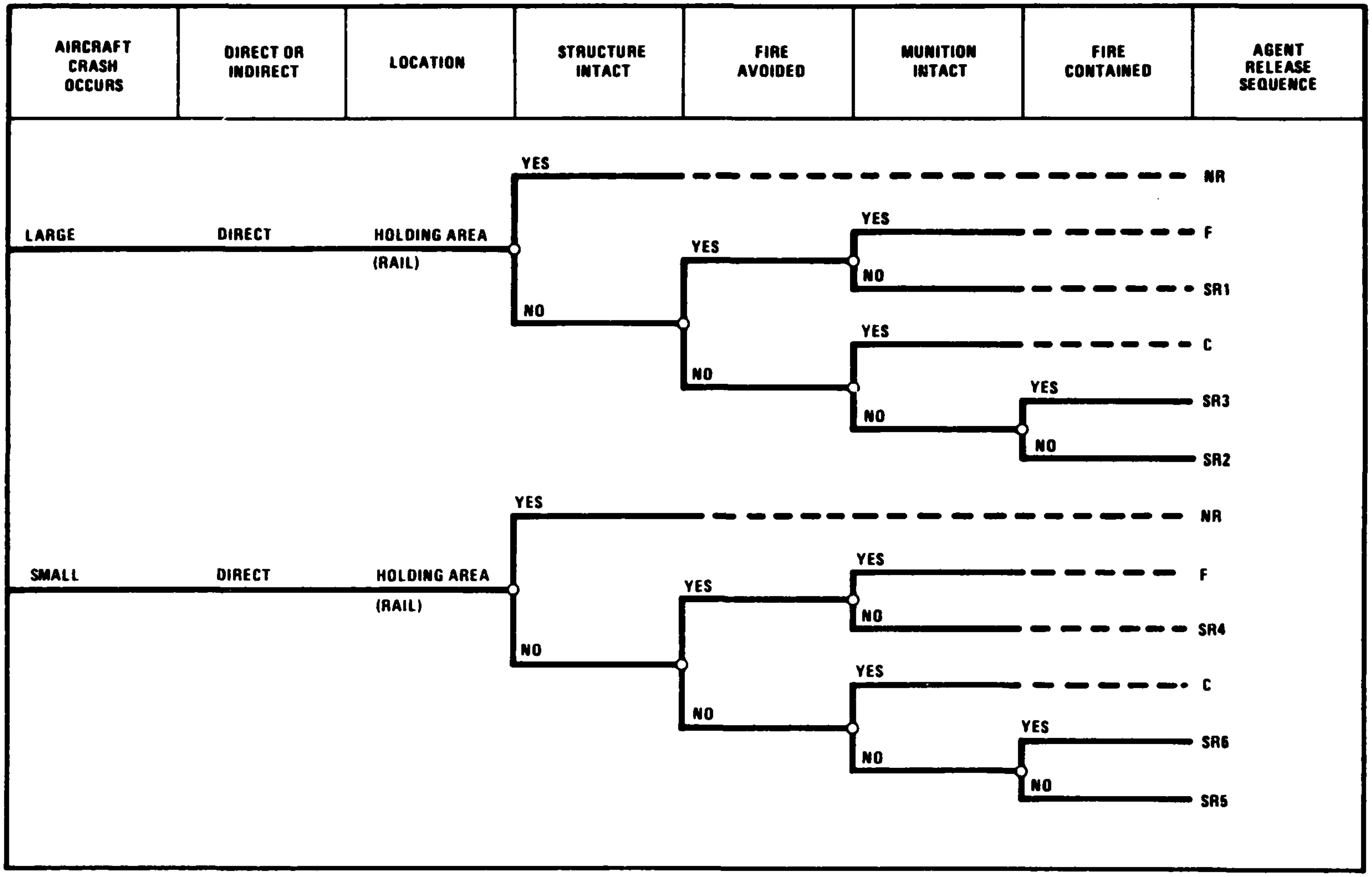


Fig. 5-7. Aircraft crash accidents involving munitions in holding area (rail option)

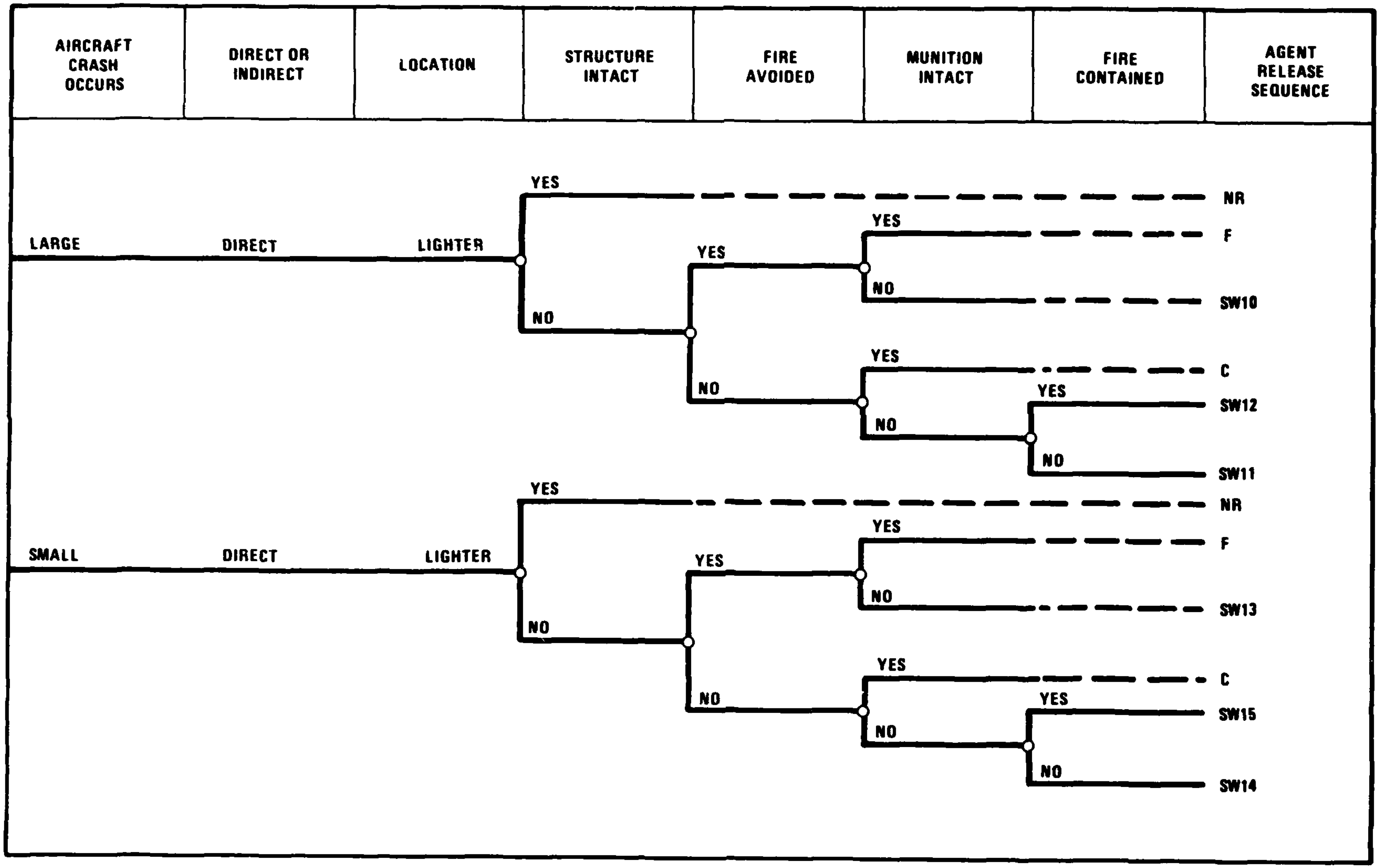


Fig. 5-8. Aircraft crash accidents involving the lighters at rest (marine option)

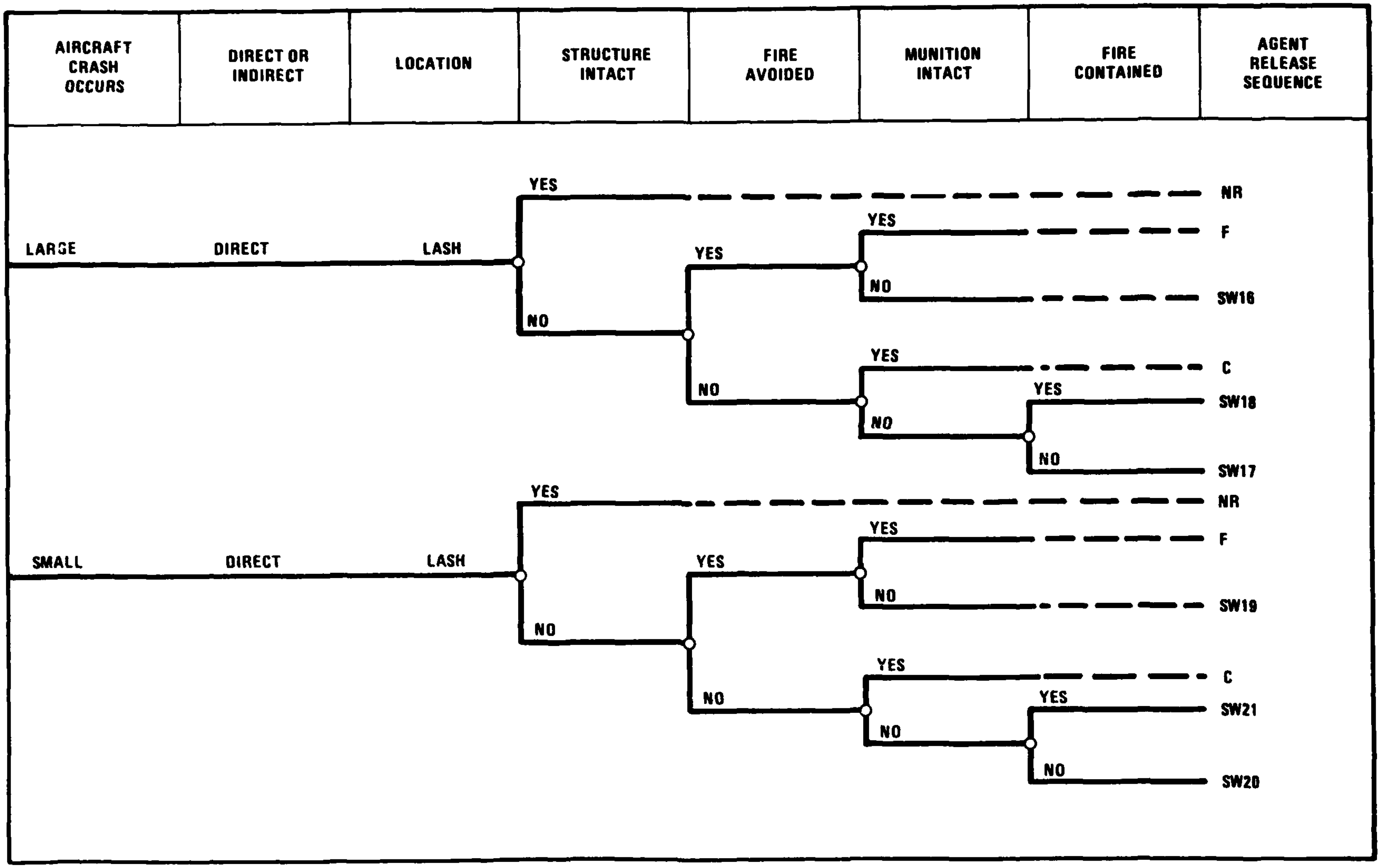


Fig. 5-9. Aircraft crash accidents involving the LASH at rest (marine option)

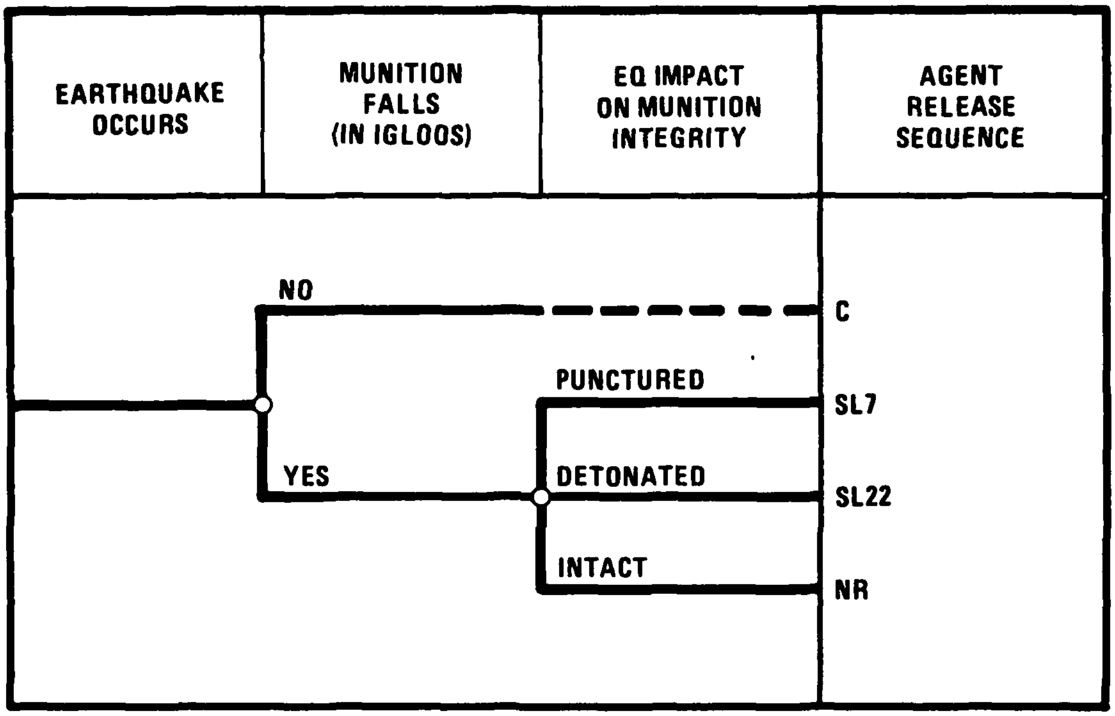


Fig. 5-10. Earthquake-induced agent releases involving munitions in storage igloos

5.2. EXTERNAL EVENTS

The external events that were evaluated include:

- Tornadoes and high winds.
- Meteorite strikes.
- Aircraft crashes.
- Earthquakes.
- Lightnings.
- Floods.

In general, the amount of agent released to the atmosphere from accidents induced by such events depends on the extent of damage incurred to the building structure and the munition itself. The munitions are currently stored in igloos, warehouses, or open storage yards. Appendix D discusses the types of storage structures present at each CONUS site, as well as the kinds of munitions stored. Munitions in OFCs and barge packages temporarily stored in open holding areas are also vulnerable to these natural and man-caused events.

5.2.1. Tornadoes and High Winds

The accident scenarios identified involve the breaching of the munitions in the storage facilities (i.e., igloos, warehouses, or open yards) by tornado- or high-wind-generated missiles. This failure mode was determined to be more credible than that identified in sequence SL14, which is a tornado/high-wind-induced building collapse that could lead to the crushing of munitions by the falling structure. For UBC designed structures such as a warehouse, the wind loads will fail the walls of the structure before the structure will collapse. Storage igloos have been designed to resist the direct effects of tornadoes with winds up to 320 mph except for the possibility of missiles breaching the

igloo doors (Ref. 5-1). For the above reasons, sequence SL14 has been screened out from further analysis.

The event tree developed to define relevant accident sequences is shown in Fig. 5-1. None of the accident sequences could be screened out initially as more detailed quantitative analysis is required to determine the necessary wind velocity to generate missiles which could penetrate the munitions. Hence, all the accident sequences shown in the event trees were quantified. They are SL6, SL23, SR7, SR8, SA7, SA8, and SW7.

Essentially, the missile penetration of the munition occurs if (1) a tornado or extremely high wind occurs with a velocity sufficient to generate a missile that could penetrate the igloo door, warehouse wall, or transportation container wall, and the munition itself; and (2) the missile actually hits the target munition.

The probability of a missile hitting and rupturing a munition is the product of four variables: (1) the probability that the velocity vector of the missile is nearly perpendicular to the target; (2) the probability that the missile is oriented properly to penetrate the target; (3) the number of missiles per square foot of wind; and (4) the target area. More details on the derivation of these variables are provided in Appendix C and Ref. 5-2.

If the missile hits a burstered munition, two failure modes are possible: (1) the munition is opened up due to puncture or crush, or (2) the missile impact causes munition detonation due to the application of a force greater than the "undue force." The undue force is defined as "a force greater than that generally required to assemble the munition" or as "any force which could cause deformation to the munition (other than minor surface deformation) or damage to the explosive train" (Ref. 5-3).

5.2.1.1. <u>Storage Magazines</u>. The analysis of the vulnerability of the igloo door to the tornado-generated missile considered the two types of igloo doors present at the CONUS sites, i.e., steel and concrete. PBA and TEAD have igloos with either steel or concrete doors, while the igloos at ANAD, LBAD, PUDA, and UMDA have steel doors only. For conservatism, all igloos at PBA and TEAD were assumed to have concrete igloo doors.

The steel doors require a missile velocity of 94 mph for penetration by a 3-in. steel pipe or 66 mph for penetration by a utility pole. For the concrete doors, the penetration velocity for a 3-in. steel pipe is 66 mph and for the utility pole, 54 mph. After penetrating the door, the remaining missile velocity must be large enough to rupture the munition. The formula for the required initial missile velocity is as follows:

$$\sqrt{V_I = V_d^2 + V_m^2} \quad , \tag{5-1}$$

where V_I = required initial velocity,
V_d = required velocity to penetrate the door,
V_m = required velocity to rupture the munition.

In order for a missile to reach the velocity required to penetrate the igloo door and the munitions inside, a wind with a significantly higher velocity is required. Table 5-3 presents the relationship between wind velocity and missile velocity.

The frequency of a wind-generated missile penetrating an igloo and a munition inside the igloo, is the product of the following:

1. The frequency of a tornado or wind which has sufficient velocity to generate a missile that can penetrate the igloo and munition.

TABLE 5-3
WINDBORNE MISSILE VELOCITIES[a]

Design Wind Speed	Horizontal Missile Velocity[b] (mph) 100	150	200	250	300	350	Maximum Height (ft)
Timber plank	60	72	90	100	125	175	200
Three-inch-diameter standard pipe	40	50	65	85	110	140	100
Utility pole	(c)	(c)	(c)	80	100	130	30
Automobile	(c)	(c)	(c)	25	45	70	30

[a]Source: Ref. 5-4.

[b]Vertical velocities are taken as 2/3 the horizontal missile velocity. Horizontal and vertical velocities should not be combined vectorially.

[c]Missile will not be picked up or sustained by the wind, however, for this analysis any initial missile velocity of 80 mph or less was assigned a wind velocity of 250 mph.

2. The probability of a missile penetrating the igloo and hitting the munition in such a way as to cause damage and is calculated as follows:

$$P_p = P_d \times P_o \times D_e \times A_t \quad , \tag{5-2}$$

where P_d = probability that the velocity of the missile is nearly perpendicular to the target plane,

P_o = probability that the missile is oriented to penetrate the target (i.e., missile not tumbling or going sideways),

D_e = density of number of missiles per square foot of wind,

A_t = target area.

Details on the calculation of these variables are given in Ref. 5-2.

The site-specific tornado frequency versus velocity curves has been presented in Section 4. Two types of missiles were initially considered: (1) a 3-in. pipe and (2) a utility pole. For all munition types, it was found that the utility pole had a higher probability of penetrating munitions.

Tables 5-4 and 5-5 present the wind velocities required to generate missiles which have sufficient velocity to penetrate the igloo door and the various munitions stored inside. Table 5-6 presents the annual frequencies of these winds occurring at each of the sites that have igloos. The frequencies were read from the curves presented in Figs. 4-9 through 4-11. The conditional probability of a missile hitting the igloo door and the munitions stored inside is 3.2×10^{-6} (see Appendix C).

TABLE 5-4
MISSILE PENETRATION THROUGH STEEL IGLOO DOORS AND MUNITIONS

Munition	Missile	Munition Rupture Velocity (mph)	Door Penetration Velocity (mph)	Required Initial Missile Velocity (mph)	Required Wind Velocity (mph)
Ton container	3-in. pipe	108	94	143	>350
	Utility pole	67	66	94	285[a]
4.2-in. mortar	3-in. pipe	60	94	112	303
	Utility pole	8	66	67	250[a]
750-lb bomb	3-in. pipe	101	94	138	347
	Utility pole	63	66	91	278[a]
8-in. projectile	3-in. pipe	162	94	187	>350
	Utility pole	25	66	71	250[a]
M23 land mine	3-in. pipe	43	94	103	286
	Utility pole	6	66	66	250[a]
M55 rocket	3-in. pipe	22	94	97	274
	Utility pole	8	66	67	250[a]

[a]Critical missile for munition.

TABLE 5-5
MISSILE PENETRATION THROUGH CONCRETE IGLOO DOORS AND MUNITONS

Munition	Missile	Munition Rupture Velocity (mph)	Door Penetration Velocity (mph)	Required Initial Missile Velocity (mph)	Required Wind Velocity (mph)
Ton container	3-in. pipe	108	66	127	329
	Utility pole	67	54	86	285[a]
4.2-in. mortar	3-in. pipe	60	66	89	258
	Utility pole	8	54	55	250[a]
750-lb bomb	3-in. pipe	101	66	121	318
	Utility pole	63	54	83	258[a]
8-in. projectile	3-in. pipe	162	66	175	>350
	Utility pole	25	54	60	250[a]
M23 land mine	3-in. pipe	43	66	79	235[a]
	Utility pole	6	54	54	250
M55 rocket	3-in. pipe	22	66	70	213[a]
	Utility pole	8	54	55	250

[a] Critical missile for munition.

TABLE 5-6
FREQUENCY OF A WIND HAZARD SUFFICIENT TO BREACH MUNITIONS IN STORAGE MAGAZINES[a] (PER YEAR)

	ANAD	LBAD	PBA[b]	PUDA	TEAD[b]	UMDA
Cartridges and mortars	1.5E-6	--	--	1.0E-7	1.8E-9	--
Projectiles	1.5E-6	1.5E-6	--	1.0E-7	1.8E-9	1.8E-9
Mines	1.5E-6	--	2.6E-6	--	4.2E-9	1.8E-9
Rockets	1.5E-6	1.5E-6	6.1E-6	--	1.5E-8	1.8E-8
Ton containers	3.8E-7	--	--	--	7.5E-10	2.4E-10
Bombs	--	--	--	--	1.1E-9	3.6E-10
Spray tanks	--	--	--	--	--	1.1E-9

[a]Frequencies obtained from the curves presented in Figs. 4-9 through 4-11.

[b]Concrete doors.

5.2.1.2. Warehouses. The warehouses at TEAD are designed for 100-mph wind loads (Ref. 5-1). Assuming that the warehouses at NAAP and UMDA are designed to the UBC requirements, they should be designed for at least 70 mph winds. An analysis of the UBC requirements shows that winds will fail the walls of UBC designed structures before the frame of the structure will fail. Based on the margins of safety required by the UBC, the concrete walls of the warehouses at TEAD are not expected to be breached by winds less than 160 mph. Breaching of the concrete walls is expected to involve cracking and spalling of the concrete and the possibility of the wall partially separating from the frame. The sheet metal walls of the warehouses at NAAP and UMDA are expected to be blown away by 115-mph winds. Neither of these failures are expected to damage the bulk containers.

In order for a wind blown missile to penetrate a spray tank in a warehouse at TEAD, it must pass through the 6-in. concrete wall, the spray tank overpack, and finally the spray tank itself. This would require a 283-mph wind.

A 250-mph wind can generate a missile that will penetrate an unprotected ton container. Since a 115-mph wind is expected to blow away the walls of the warehouses at NAAP and UMDA, the walls will offer no protection. Therefore, a 250-mph wind has the potential to generate missiles that will penetrate the ton containers stored in these warehouses. Table 5-6 presents the frequency of occurrence of such winds at these sites. The conditional probability of a missile hitting a ton container in an orientation which could breach the container is 2.2×10^{-4} at NAAP and 2.7×10^{-4} at UMDA (see Appendix C).

5.2.1.3. Open Storage. Ton containers are stored in open storage at APG, PBA, and TEAD. A wind velocity of 250 mph is required to generate a missile that can penetrate these ton containers. The freq[illegible] generating the 250-mph wind are presented in Table 5-7. The probability of a missile hitting a ton container in an or[illegible] could breach the container is 6.6×10^{-4} (see Appendix [illegible]

AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO CA A W BARSELL ET AL. AUG 87 GA-C-18563 3/13

UNCLASSIFIED SAPEO-CDE-IS-87008 DAAA15-85-D-0022 F/G 15/6.3 NL

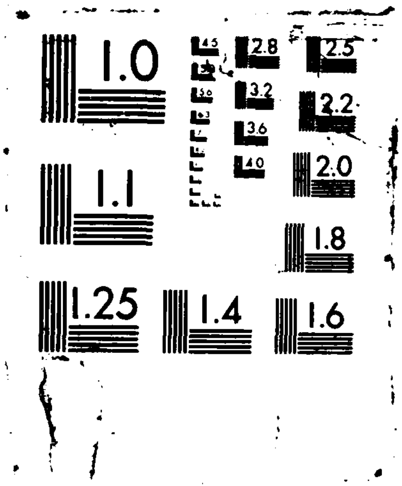

1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

TABLE 5-7
FREQUENCIES FOR WIND-GENERATED MISSILE PENETRATION OF TON CONTAINERS AND SPRAY TANKS STORED IN WAREHOUSES AND OPEN STORAGE

Site	Storage	Required Wind	Frequency of Wind	Probability of Hitting and Rupturing TC
APG	Open	250	1.0E-7	6.6E-4
PBA	Open	250	1.5E-6	6.6E-4
NAAP	Warehouse[a]	250	1.5E-6	2.2E-4
UMDA	Warehouse[a]	250	1.8E-9	2.7E-4
TEAD	Warehouse[b]	283	2.7E-10	4.4E-4

[a]Metal walls.

[b]Concrete walls.

5.2.1.4. <u>Tornado-Generated Missiles Cause Munition Detonation</u>. The analysis of scenario SL23 included the estimation of the probability that a missile impacting a munition would cause it to detonate or in the case of rockets, cause the rocket motor to ignite and subsequently detonate the burster. The data presented in Ref. 5-5 indicated that a projectile with Comp B explosive could ignite when subjected to a minimum impact velocity of 123 mph. Because the conditions of the tests described in Ref. 5-5 do not fully apply to the conditions being considered here (i.e., the shell casing provides protection for the bursters), it is assumed that there is a 50% chance that a munition will detonate at 123 mph. Furthermore, Army data indicate that dropping of thousands of burstered munitions from 40 ft did not lead to any detonations (Ref. 5-6). However, these are newer munitions and do not fully represent the chemical munitions in the stockpile. Therefore, based on the consensus of risk experts (Ref. 5-19), an estimated probability of 10^{-6}/munition was assigned to all drops of 6 ft or lower (equivalent to a free fall drop of 13.5 mph). To determine the probability of detonating a munition at an impact velocity equivalent to that of a missile required to penetrate the igloo and the munition, we assumed a lognormal distribution and derived the necessary parameters (e.g., standard deviation and standard normal deviate) from these two data points. The calculation details are given in the calculation sheets (Ref. 5-2).

The overall frequency for this scenario is the product of the following:

1. The frequency of a tornado or wind which has sufficient velocity to generate a missile that can penetrate the igloo and munition.

2. The probability of a missile penetrating the igloo and hitting the munition in such a way as to cause damage.

3. The probability of burster detonation from impact.

The values for the first two variables have already been presented in Section 5.2.1.1. The probability of a detonation given penetration of burstered munitions stored inside the igloos with steel doors is 0.07 and for concrete doors, 0.055. See Ref. 5-2 for calculations.

5.2.1.5. Holding Areas. The holding area is a concrete pad constructed to support equipment for loading containers onto a train, aircraft, or barge. The analysis was based on the following assumptions:

1. The maximum number of containers stored at the holding area at any given time is 140 for the rail and barge options and 15 for the air option.

2. Since no design information or data is given regarding the holding area nor the arrangement of the containers in the holding area, the largest possible target area for potential missile penetration is used. The target area is munition specific and is a function of the arrangement of the munitions inside the containers and the packing density.

3. The puncture resistance for the OFC and the barge package is assumed to be equivalent to 0.75-in thick steel. This is in accordance with the package design criteria provided by MITRE.

Table 5-8 gives the windborne missile velocities for munitions in OFC. The critical missile is the utility pole. Table 5-9 gives the wind frequency sufficient to breach the munitions at the various sites. These frequencies were read from the curves presented in Figs. 4-9 through 4-11. The conditional probability of a missile hitting the munition as calculated using Eq. 5-2 is given in Table 5-10. The target area is munition specific and is calculated as follows based on the package configuration given in Ref. 5-7:

$$A = N \times H \times L/144 \quad , \tag{5-3}$$

TABLE 5-8
WINDBORNE MISSILE VELOCITY (HOLDING/LOADING AREA - RAIL/AIR OPTION)

Munition	Container Penetration Velocity, V_c (mph)	Munition Rupture Velocity, V_m (mph)	Required Initial Missile Velocity, V (mph)	Required Wind Velocity (mph)
Ton container	106	67	125	342
4.2-in. mortar	106	8	106	310
750-lb bomb	106	63	123	338
8-in. projectile	106	25	109	315
M23 land mine	106	6	106	310
105-mm projectile	106	17	107	312
M55 rocket	106	8	106	310
Spray tank with overpack	106	51	118	330

Notes: 1. Critical missile is the utility pole.

2. See Ref. 5-2 for details.

TABLE 5-9
PROBABILITY OF A WIND SUFFICIENT TO GENERATE MISSILES TO BEACH MUNITION (HOLDING/LOADING AREA - RAIL/AIR OPTION)

Munition	Required Windborne Missile Velocity[a] (mph)	Probability of Occurrence/Year (P_w) — Transportation Container (TRC) in Holding/Loading Area (Sending or Receiving Site)		
		Zone I[b]	Zone II[c]	Zone III[d]
Ton container	342	8.9E-12	1.4E-9	4.3E-8
4.2-in. mortar	310	5.6E-11	6.3E-9	1.5E-7
750-lb bomb	338	1.1E-11	1.7E-9	5.0E-8
8-in. projectile	315	4.2E-11	5.0E-9	1.2E-7
M23 land mine	310	5.6E-11	6.3E-9	1.5E-7
105-mm projectile	312	5.0E-11	5.8E-9	1.4E-7
M55 rocket	310	5.6E-11	6.3E-9	1.5E-7
Spray tank with overpack	330	1.8E-11	2.5E-9	6.8E-8

[a]From Table 5-8.

[b]Zone I - TEAD and UMDA sites (probability values obtained from Fig. 4-9).

[c]Zone II - PUDA and APG sites (probability values obtained from Fig. 4-10).

[d]Zone III - ANAD, PBA, LBAD, and NAAP sites (probability values obtained from Fig. 4-11).

TABLE 5-10
PROBABILLITY OF MISSILE STRIKING MUNITIONS IN HOLDING/LOADING AREA (RAIL/AIR OPTION)

Munition	P_d Missile Velocity Probability	P_o Missile Axis Probability	D_E Missile Density ($1/ft^2$)	A_T Target Area (ft^2)	P_p(a) Conditional Probability of Munition Rupture
Ton container	0.17	0.015	1.9×10^{-5}	1155	5.6×10^{-5}
4.2-in. mortar	0.17	0.015	1.9×10^{-5}	2036	9.9×10^{-5}
750-lb bomb	0.17	0.015	1.9×10^{-5}	1792	8.7×10^{-5}
8-in. projectile	0.17	0.015	1.9×10^{-5}	1329	6.4×10^{-5}
M23 land mine	0.17	0.015	1.9×10^{-5}	1805	8.7×10^{-5}
105-mm projectile	0.17	0.015	1.9×10^{-5}	1341	6.5×10^{-5}
M55 rocket	0.17	0.015	1.9×10^{-5}	2195	1.1×10^{-4}
Spray tank with overpack	0.17	0.015	1.9×10^{-5}	1966	9.5×10^{-5}

(a) For air option multiply P_p by (15/140).

where N = number of munition pallets that a missile could hit,

H = effective height of the pallet (in.),

L = effective length or width of the pallet, whichever gives the most critical target area.

Table 5-11 gives the windborne missile velocity for the vault, the wind frequency sufficient to generate missiles, and the probability of the missile hitting and rupturing the munitions, based on Eqs. 5-1 through 5-3. Calculations are provided in Ref. 5-2.

For the marine option, the tornado scenario addressed only the packages temporarily stored in the holding area. A tornado-generated missile strike of the lighter or ship at rest was not considered credible.

5.2.2. Meteorite Strikes

Like tornado-generated missiles, meteorites striking the igloos, warehouses, and the outdoor yards can lead to a significant amount of agent release. The consequence of such an accident is more severe than that from a tornado-generated missile because meteorite strikes generally involve fires. Hence, if bursterd munitions are involved, explosive detonations could occur from the fire or from direct impact, leading to instantaneous agent releases.

The event tree developed for meteorite-initiated accidents is shown in Fig. 5-2. The scenarios could not be subjected to any preliminary screening without doing a more detailed analysis of the what type (stone or iron) and size of meteorite is capable of penetrating munitions stored igloos, warehouses, or outdoors. The accident sequences identified are: SL8, SR9, SA9, and SW9.

TABLE 5-11
TORNADO-GENERATION MISSILE ANALYSIS OF THE VAULT (MARINE OPTION)[a]

	Windborne Missile Velocity (mph)					
	Package Penetration	Munition Penetration	Required Initial Velocity	Required Wind Velocity	Tornado Frequency/yr	Probability of Munition Penetration
Ton container at APG (Tornado Zone II)	106	67	125	342	1.4E-9	4.6E-4

[a] See Ref. 5-2 for details.

Storage Magazines

In this scenario (SL8), the meteorite penetrates the storage magazine and ruptures some of the munitions stored inside. The meteorite is expected to be sufficiently hot to cause ignition of the exposed burster, propellant, and/or agent. The fire is expected to spread, resulting in the destruction of the entire inventory of the storage magazine.

Warehouses

This scenario is similar to the storage magazines. The meteorite penetrates the warehouse and ruptures some of the bulk munitions stored inside. The meteorite causes the ignition of the exposed agent. Fire spreads and results in the destruction of the entire warehouse inventory.

Open Storage

In this scenario, the meteorite directly impacts and ruptures some ton containers. The heat from the meteorite is expected to ignite the exposed agent, but is not expected to cause the rupture of additional munitions.

Holding Area

This scenario (sequences SR9, SA9, SW9) applies to munitions in OFCs and barge packages temporarily stored in the holding area. As with the tornado-generated missile scenario, the OFC or barge package provide the first structural barrier for missile penetration. The same assumptions used in the tornado analysis apply here. For the marine option, the meteorite strike scenario addressed only the packages temporarily stored in the holding areas. A meteorite strike while munitions are in the lighter or ship at rest was not considered credible.

5.2.2.1. Meteorite Strike Accident Analysis. About 3500 meteorites, each weighing over 1 lb, strike the earth each year; the majority of them are of small sizes (Ref. 5-8). Given the earth's surface area of 5.48×10^{-15} ft^2, the frequency of meteorite strikes for meteorites weighing 1.0 lb or greater is $6.4 \times 10^{-13}/ft^2$ (Ref. 5-8). For meteorites one ton or less, stone meteorites are approximately 10 times more common than iron. However, iron meteorites are more dense and tend to have higher impact velocities and therefore represent a significant portion of the total meteorites that can rupture the munitions. Table 4-18 shows the size distribution of both iron and stone meteorites. The table was compiled from data presented in Refs. 5-8 and 5-9.

For agent to be released, the meteorite has to penetrate the storage structure and the munition wall. In the case of an igloo, this would require initial penetration of a 6-in. concrete roof. The minimum meteorite impact velocity that would collapse the earth cover and the 6-in. concrete roof is 1500 fps for stone meteorite and 3800 fps for iron meteorite. The overall frequency of a meteorite capable of penetrating and rupturing the munitions in the igloo is:

$$P = F\ (F_s + F_i)\ A \times S \quad , \qquad (5\text{-}4)$$

where F = the frequency of a meteorite weighing one pound or more striking the earth, $6.4 \times 10^{-13}/ft^2$,

F_s = fraction of stone meteorites which can penetrate the target,

F_i = fraction of iron meteorites which can penetrate the target,

A = target area (igloo, warehouse, or open storage yard,

S = spacing factor.

Table 5-12 presents the frequencies for meteorite penetration of munitions stored in the various storage configurations along with the size of the meteorites required to penetrate the munitions and the data

TABLE 5-12
METEORITE REQUIRED FOR PENETRATION OF MUNITIONS IN STORAGE

Storage Area	Munition	Stone Meteorite Weight (lb)	Stone Meteorite Fraction (fs)	Iron Meteorite Weight (lb)	Iron Meteorite Fraction (fi)	Target Area (ft^2) (A)	Spacing Factor (s)
Igloo	All	1,000	0.02	200	0.003	960	0.5
Warehouse-NAAP	Ton container	20	0.11	2	0.03	22,000	0.5
Warehouse-UMDA	Ton container	20	0.11	2	0.03	46,000	0.4
Warehouse-TEAD	Spray tank	100	0.08	10	0.02	67,000	0.4
Open	Ton container	20	0.11	2	0.03	139[a]	1.0
Rail holding area	All	100	0.05	20	0.013	154,000[b]	0.030 to 0.053[c]
Air holding area	Ton container, projectile, rocket	100	0.05	20	0.013	16,500[d]	0.030 to 0.035[c]
Marine holding area	Ton container	100	0.05	20	0.013	50,400[e]	0.19

[a] Area of one pallet (15 ton containers stacked two high).

[b] 700 x 220 ft (Ref. 5-17).

[c] Spacing factor is munition specific. See Ref. 5-2 for details.

[d] (15/140) (154,000).

[e] Based on 14 x 10 array of 106 x 44 x 54 in. vaults with 1-ft clearance.

required to evaluate Eq. 5-4. Supporting calculations are presented in Ref. 5-2, and the methodology is discussed in Appendix C.

5.2.3. Aircraft Crashes

The sequences describing the effects of an aircraft crash on munitions in storage are SL4, SL5, SL15, SL16, SL17, SL18, SL19, SL20, SL21, SR1 through SR6, SA1 through SA6, SW1 through SW6, and SW10 through SW21.

The effects of large (>12,500 lb) and small (12,500 lb or less, including helicopters) aircraft crashes on the munitions in storage igloos, warehouses, and open yards were evaluated. Because of the potential for large quantities of fuel to be carried by large aircraft and the potential for large, high-velocity missiles (e.g., engines), the large aircraft crash scenarios were further divided into direct and indirect crashes. For direct and indirect large aircraft crashes onto the storage area that do not result in fire, it is assumed that the impact of the crash is strong enough to cause the detonation of burstered munitions. For munitions in OFCs or vaults, only direct aircraft crashes were considered, since the target area considered was large enough to include indirect hits and the effects on the munitions will be the same.

For a small aircraft crash adjacent to the storage site to produce a credible event, the crash would have to be so close that it would virtually be a direct hit. Therefore, the small aircraft crash scenarios address only direct hits into the storage areas including holding areas.

The event trees developed to identify the agent release scenarios from aircraft crashes are shown in Figs. 5-3 through 5-9.

5.2.3.1. Aircraft Crash Accident Analysis. In summary, the following general assumptions were made in deriving the large/small aircraft accident scenarios:

1. For large aircraft crashes onto burstered munitions, it is assumed that detonations will occur for both indirect and direct hits, and, if a fire occurs, it is uncontained.

2. No small aircraft crashes were assumed to be able to sufficiently damage the igloo to cause agent releases.

Direct Crash of Large Aircraft (Sequences SL4, SL16, SL17, SR1 Through SR3, SA1 Through SA3, SW1 Through SW3, SW10 Through SW12, and SW16 Through SW18)

For a direct aircraft crash, the target area is the surface area of the building or open yard.

Storage Magazines. The direct crash of the main body of a heavy military or commercial aircraft into the shell or front face of a storage magazine (igloo) can breach the igloo and allow crash-generated missiles and/or aviation fuel to enter into the igloo. There is a high probability that one or more munitions will be crushed or punctured by the missiles. Burstered munitions could also detonate from impact. If the crash produces a fire, the fire is expected to spread through the igloo, resulting in the destruction of the entire igloo inventory.

Warehouses. Since a warehouse is not expected to offer any substantial resistance to the crash of a large aicraft, the direct impact of any part of a large airacraft is expected to breach the warehouse and subject the stored munitions to crash-generated missiles. Bulk containers will be crushed or punctured. If the crash produces a fire, the fire is expected to spread, resulting in the destruction of the entire inventory.

Open Storage. The crash of a large aircraft into an open area is expected to breach a large number of ton containers. If the crash produces a fire, and it is not contained, it is expected to breach additional containers in the immediate vicinity of the initial container that is on fire.

Holding Area. The crash of a large aircraft onto the OFCs temporarily stored in the holding area is expected to breach a large number of munitions. For the rail and marine options analysis, the 140 OFCs are assumed to be arranged in a 14 by 10 array in the holding area. This configuration was used to determine the target area for a plane crash. Since there will only be 15 OFCs in the holding area for the air option, the target area was adjusted proportionately.

Lighter/LASH at Rest. For the marine option, the direct crash of a large aircraft onto (1) a flotilla of lighters while awaiting loading onto a LASH and (2) LASH vessel were also considered. Ten lighters are assumed to be in the area at any given time. The size of a lighter is 6.88×10^{-5} mi^2. The size of a LASH is 2.94×10^{-3} mi^2. The entire time for operations of loading the lighters and the LASH is expected to be 14 days. Hence, the lighters and the LASH will be exposed for only a fraction of the year (i.e., 14 days/365 days).

Indirect Crash of a Large Aircraft (Sequences SL5, SL20, SL21)

For an indirect crash, the target area is determined by increasing all perimeters for the direct crash by 200 ft.

Storage Magazines. Should a large aircraft crash adjacent to an igloo, the area that is most vulnerable is the igloo door. The crash-generated missiles can breach the igloo door which essentially provides a pathway to the breaching of munitions in the line of site of the missile. Alternatively, the igloo door may already be open at the time of the crash and the missile could directly penetrate the munitions. If

fire is involved, the missile could already be on fire or the fire could propagate into the igloo opening. Thus, if fire is not contained, the amount of agent release is the same as for the direct crash of a large aircraft into an igloo.

Warehouses. The designs of the warehouses are such that the crash of a large aircraft into an area adjacent to a warehouse may also breach the warehouse if the aircraft is flying towards the warehouse at the time of the crash. The amount of munitions that are initially impacted would be less than the direct crash scenario. However, if fire is involved and uncontained, the amount of agent release is the same as for the diect crash of large aircraft into a warehouse.

Open Storage. The accident scenario for the crash of a large aircraft into an area adjacent to the open storage area considers that there is a 50% chance that some ton containers would be breached by the crash-generated missile. If fire is involved and not contained, additional containers would rupture due to excessive heating.

Holding Area. This scenario was not considered for the munitions in OFCs or barge package temporarily stored in the holding area since the effects on the munitions will be the same as the direct crash.

Lighter/LASH at Rest. This scenario was not considered for the marine option since the target area considered for the direct crash was sufficient to include indirect hits, and the effects on the munitions will be the same as the direct crash.

Direct Crash of a Small Aircraft (Sequences SL15, SL18, SL19, SR4 Through SR6, SA4 Through SA6, SW4 Through SW6, SW13 Through SW15, and SW19 Through SW21)

Storage Magazines. Due to the high strength of the storage magazine, the crash of a small aircraft is not expected to breach an igloo or affect the structural integrity of an igloo.

Warehouses. The crash of a small aircraft into a warehouse would very likely breach the warehouse. The resulting crash-generated missiles are expected to crush or puncture some munitions. If the crash produces a fire and it is not contained, the fire would involve the entire inventory.

Open Storage. The crash of a small aircraft into an open storage area is similar to the large aircraft crash into an open storage area except a smaller number of ton containers is breached.

Lighter/LASH at Rest. The crash of a small aircraft onto a flotilla of lighters or onto the LASH vessel is similar to the large aircraft crash except that the extent of damage could be less severe.

5.2.3.2. Aircraft Crash Frequency. The frequency of an aircraft crashing while in an airway or the vicinity of an airport can be computed as shown in Section 4.2.1.3.

The annual frequency of a crash into a specific facility was computed by multiplying the appropriate frequency taken from Table 4-16 by the effective target area of the facility (see Appendix C). Table 5-13 summarizes these annual frequencies. The calculations of the effective areas are contained in Ref. 5-2 and take into account such factors as aircraft wing span, facility height, and facility vulnerability.

5.2.3.3. Probability of Fire Resulting From An Aircraft Crash. The probability of a fire resulting from the crash has been estimated to be 0.45 (Ref. 5-12). The successful containment of the fire is defined here to be 0.5 h for unpackaged nonburstered munitions. This time was selected based on the thermal failure threshold data presented in Appendix F, which indicate that direct heating of ton containers for 36 min leads to hydraulic rupture. For unpackaged burstered munitions, the thermal failure threshold range from 4 min for rockets to 23 min for mines. Since the Army policy is not to fight a fire involving direct

TABLE 5-13
DATA BASE FOR AIRCRAFT CRASH-INITIATED SCENARIOS FOR STORAGE

Event	Variable ID	Frequency or Probability	Unit	Error Factor	Reference
Large aircraft direct crash storage area:					
ANAD - 60 ft igloo	LDANI60	4.5E-10	Per facility year	10	Ref. 5-2
ANAD - 80 ft igloo	LDANI80	6.0E-10		10	
APG - open	LDAPOP	2.4E-09		10	
LBAD - 89 ft igloo	LDLBI89	3.7E-10		10	
NAAP - wh	LDNAWH	3.6E-09		10	
PBA - 80 ft igloo	LPDBI80	1.1E-10		10	
- open	LDPBOP	1.7E-08		10	
PUDA - 80 ft igloo	LDPUI80	4.5E-09		10	
TEAD - 80 ft igloo	LDTEI80	2.7E-11		10	
- 89 ft igloo	LDTEI89	3.0E-11		10	
- wh	LDTEWH	8.7E-10		10	
- open	LDTEOP	7.9E-09		10	
UMDA - 80 ft igloo	LDUMI80	1.1E-09		10	
- wh	LDUMWH	2.5E-08			
Large aircraft indirect crash:					
ANAD - 60 ft igloo	LAANI60	5.5E-08	Per facility year	10	Ref. 5-2
ANAD - 80 ft igloo	LAANI80	5.7E-08		10	
APG - open	LAAPOP	9.4E-09		10	
LBAD - 89 ft igloo	LALBI89	3.3E-08		10	
NAAP - wh	LANAWH	5.0E-08		10	
PBA - 80 ft igloo	LAPBI80	1.1E-08		10	
- open	LAPBOP	3.5E-08		10	
PUDA - 80 ft igloo	LAPUI80	4.3E-07		10	
TEAD - 80 ft igloo	LATEI80	2.6E-09		10	
- 89 ft igloo	LATEI89	2.7E-09		10	
- wh	LATEWH	7.9E-09		10	
- open	LATEOP	1.3E-08		10	

TABLE 5-13 (Continued)

Event	Variable ID	Frequency or Probability	Unit	Error Factor	Reference
UMDA - 80 ft igloo - wh	LAUMI80 LAUMWH	1.1E-07 1.3E-07	Per facility year	10	
Igloo breached given direct crash	ID	8.0E-01	None	1.4	EJ
Igloo breached given indirect crash	IA	2.3E-03	None	3	Ref. 5-2
Warehouse/outdoor container breached (direct crash)	WHD	1.0E+00	None	None	EJ
Warehouse breached given indirect crash	WHA	1.7E-01	None	2	Ref. 5-2
Outdoor container breached (indirect crash)	OA	5.0E-01	None	1.4	Ref. 5-2
Crash does not involve fire	NF	5.5E-01	None	None	Ref. 5-10
Crash results in fire	YF	4.5E-01	None	None	Ref. 5-10
Fire not contained in 1/2 h (urstered)	FNCD	1.0E+00	None	None	Ref. 5-2 and Appendix J
Fire contained in 1/2 h (nonburstered)	FCNB	3.4E-04	None	3	Ref. 5-2 and Appendix J
Fire not contained in 1/2 h (nonburstered)	FNCNB	1.0E+00	None	None	Ref. 5-2 and Appendix J
Fire contained (wh or op) small	SFNB	1.9E-02	None	3	Ref. 5-2
Small aircraft crash warehouse NAAP	SANAAP	1.8E-08	Per facility year	10	Ref. 5-2

TABLE 5-13 (Continued)

Event	Variable ID	Frequency or Probability	Unit	Error Factor	Reference
Small aircraft crash warehouse UMDA	SAUMDA	2.0E-08	Per facility year	10	Ref. 5-2
Small aircraft crash warehouse TEAD	SATEAD	3.5E-08		10	Ref. 5-2
Small aircraft crash open APG	SAOAPG	3.6E-05		10	Ref. 5-2
Small aircraft crash open PBA	SAOPBA	1.3E-06		10	Ref. 5-2
Small aircraft crash open TEAD	SAOTEAD	3.2E-07		10	Ref. 5-2
Large aircraft direct crash holding area (rail and marine):					
ANAD	LDHAN	1.4E-08	Per year	10	Ref. 5-2
APG	LDHAP	9.6E-10	Per year	10	
LBAD	LDHLB	8.1E-09	Per year	10	
NAAP	LDHNA	8.3E-09	Per year	10	
PBA	LDHPB	2.7E-09	Per year	10	
PUDA	LDHPU	1.1E-07	Per year	10	
TEAD	LDHTE	6.5E-10	Per year	10	
UMDA	LDHUM	2.7E-08	Per year	10	
Small aircraft direct crash holding area (rail and marine):					
ANAD	SDHAN	2.2E-08	Per year	10	Ref. 5-2
APG	SDHAP	1.4E-05	Per year	10	
LBAD	SDHLB	3.3E-10	Per year	10	
NAAP	SDHNA	4.2E-08	Per year	10	
PBA	SDHPB	2.0E-07	Per year	10	
PUDA	SDHPU	1.8E-07	Per year	10	
TEAD	SDHTE	2.6E-08	Per year	10	
UMDA	SDHUM	2.2E-08	Per year	10	

TABLE 5-13 (Continued)

Event	Variable ID	Frequency or Probability	Unit	Error Factor	Reference
Fire contained (offsite) large aircraft	LFC2	3.5E-01	None	2	Ref. 5-2
Fire contained (offsite) small aircraft	SFC2	8.7E-01	None		Ref. 5-2
Large aircraft direct crash holding area (air):					
APG	ALAP	1.1E-09	Per year	10	Ref. 5-2
LBAD	ALLB	5.8E-09	Per year	10	
TEAD	ALTE	6.0E-09	Per year	10	
Small aircraft direct crash holding area (air):					
APG	ASAP	1.5E-06	Per year	10	Ref. 5-2
LBAD	ASLB	3.5E-11	Per year	10	
TEAD	ASTE	2.8E-09	Per year	10	
Large aircraft crash (marine only) crashes/year					
Lighter	BLHDAP	1.4E-11	Per year	10	Ref. 5-2
Ship	SLHDAP	6.0E-11	Per year	10	Ref. 5-2
Small aircraft crash (marine only)					
Lighter	DSHDAP	2.1E-07	Per year	10	Ref. 5-2
Ship	SSHDAP	8.8E-07	Per year	10	Ref. 5-2

heating of burstered munitions, the probability of the "failure to contain fire" event is essentially 1.0.

Thus, the amount of agent released from bulk containers subjected to aircraft crash fires depends on the ability to contain the fire. If fire is allowed to progress for more than 30 min, more containers will rupture.

The ability of the fire-fighting team to extinguish an aircraft crash fire depends on many variables such as the precise crash site, the burn time of the resulting fire, the availability of resources necessary to contain the fire, etc. If fire fighters arrive at the crash site in a relatively short period of time, the fire will be easier to extinguish since it is not likely to have spread very far. Because the fire will involve chemical agent, additional precautions will have be taken before the fire-fighting team can start extinguishing the fire. Their arrival at the perimeter of the MDB or MHI is assumed to occur about 5 min after the crash. The crew will have to put on agent protective clothing in addition to their normal, fire-fighting suits of thermal protective clothing. Donning these clothes and checking for proper mask fit would take several more minutes, if it is assumed that the crew was partially dressed; i.e., in a standby readiness mode. Because of all the detection, observation, communication, preparation, and travel tasks involved, it is estimated that it would take the fire-fighting team 15 min to get to the scene of the fire.

Once at the scene, the time it takes to actually extinguish the fire is difficult to estimate. GA interviewed local fire fighting personnel to get their opinion on how long it takes to extinguish a fire from a small aircraft crash versus large aircraft crash. No definite time can be given because of the many variables involved. But based on local experience, it would take 1 to 3 h to extinguish a fire from a small aircraft; while it would take 3 to 10 h for a large aircraft fire. Using the lognormal distribution, GA then derived the probability of

containing the fire in 0.5 h or less and took no credit for the first 15 min of the fire. More details are provided in the calculation sheets (Ref. 5-2).

For munitions in OFCs or barge packages, it is assumed that the intact containers can withstand a 2-h all engulfing fire. Therefore, the successful fire containment for the SR, SA, and SW aircraft fire scenarios is defined as the ability to put out the fire in 2.5 h since thermal rupture of munitions take additional minutes.

5.2.4. Earthquakes

5.2.4.1. Storage Magazines. The earthquake-initiated accident affecting the storage igloos assumes that the earthquake causes the munitions in the igloo to fall and be punctured given the presence of a probe on the igloo floor or the fall could cause a burstered munition to detonate (Sequence SL7). This sequence is modeled using the event tree illustrated in Fig. 5-10.

The storage magazines are expected to survive the largest credible earthquake with little or no damage. Some cracking or spalling of the concrete is possible, but this should not produce a threat to the munitions or significantly change the containment capability of the magazine. Igloos have been tested by very large external explosions and have survived without damage (Ref. 5-11). The data from these tests indicate that the igloo experienced accelerations which were in excess of 20 g. Though an explosion is not as potentially damaging to an igloo as an earthquake of equal acceleration, the similarities are sufficient to conclude that a very large earthquake, in the range of 1.0 g, is not likely to damage an igloo.

Sequence SL7 postulates that the earthquake causes the stacked munitions to fall and may be punctured upon impact. Based on the coefficient of friction between pallets of munitions, a 0.3-g earthquake

will likely cause some stacked munitions to fall and a 0.5-g earthquake will cause a large number to fall. The highest stacked munitions in an igloo can potentially fall 6 ft. The munition failure threshold data indicate that all palletized munitions and bulk containers can survive the impact of a drop from this height but could be punctured if they were to land on a probe which was sufficiently sharp and rigid. For this analysis a 0.3-g earthquake was assumed to cause 25% of the stacked pallets to fall while a 0.5-g earthquake will cause 100% of the stacked pallets to fall. The number of pallets which have the potential of impacting a probe was estimated for each munition type based on (1) how the pallets are stacked and (2) the floor area available for the pallets to fall. The calculation details are provided in Ref. 5-2.

The analysis of the presence of a probe in the igloo has indicated that it is unlikely that there is a probe inside the igloo that is sufficiently rigid and sharp to damage a munition. Table 5-14 provides the earthquake frequency data for each of the eight sites and the puncture probability of a munition type given a 6-ft drop.

Sequence SL22 involves the detonation of burstered munitions resulting from an earthquake-induced fall. The probability of a munition detonating from a 6-ft drop is estimated using the same approach discussed for detonations due to impact by wind-generated missiles.

5.2.4.2. Warehouses. The event tree describing release scenarios resulting from earthquake-induced accidents in warehouses is shown in Fig. 5-11. The event tree applies to the long-term storage warehouses at TEAD, NAAP, and UMDA. Spray tanks are stored at the two warehouses at TEAD. Ton containers are stored at NAAP in one warehouse and at UMDA in two adjacent warehouses.

Accident sequences describing releases from long-term storage warehouses are given in Table 5-15. Sequence designations are SLxxx26x for the NAAP warehouse, SLxxx27x for the TEAD warehouses, and SLxxx28x

TABLE 5-14
DATA BASE FOR ANALYSIS OF EARTHQUAKE-INDUCED AGENT RELEASE IN THE STORAGE IGLOOS

	Map Area 5 Site: TEAD	Map Area 2 Site: ANAD, LBAD, PBA, UMDA, and PUDA
Earthquake frequency (/yr) at		
0.3 to 0.5 g (F_1)	6.0E-4	1.9E-5
>0.5 g (F_2)	1.0E-4	6.0E-6
Probability stacked pallets will fall at		
0.3 to 0.5 g (P_1)	0.25	0.25
>0.5 g (P_2)	1.0	1.0

	Number of Munitions Falling At	
Munition Type	(N_1) 0.3 to 0.5 g	(N_2) >0.5 g
Bomb	3	11
105-mm cartridge	5	20
4.2-in. mortar	5	18
Ton container	6	22
Mine	4	14
Projectile	11	46
Rocket	5	20
Spray tank	N/A	N/A

SL7 (accident frequency) = $(F_1 * P_1 * N_1) + (F_2 * P_2 * N_2)$

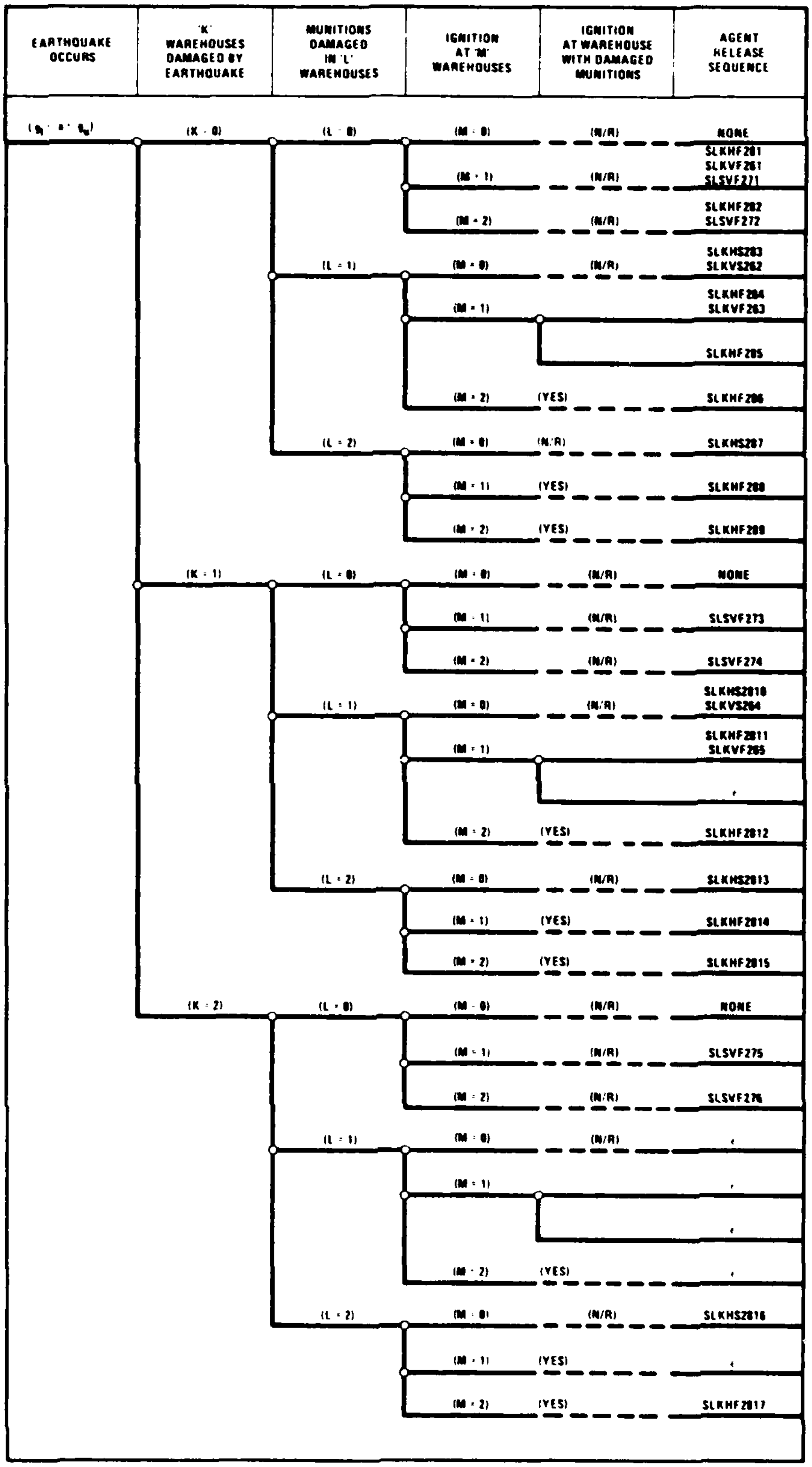


Fig. 5-11. Earthquake-induced releases from the warehouses

TABLE 5-15
EARTHQUAKE-INDUCED ACCIDENTS IN WAREHOUSES

21-Aug-87 PAGE 1

STORAGE EARTHQUAKE - WAREHOUSES

STORAGE - EARTHQUAKE-INDUCED ACCIDENTS IN THE WAREHOUSES
(PER YEAR)

ACCIDENT FREQUENCIES

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLKVF	261	N/A	N/A	N/A	N/A	N/A	N/A	1.1E-06	1.0E+01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SLKVC	262	N/A	N/A	N/A	N/A	N/A	N/A	9.5E-07	2.0E+01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SLKVF	263	N/A	N/A	N/A	N/A	N/A	N/A	1.1E-09	2.9E+01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SLKVF	264	N/A	N/A	N/A	N/A	N/A	N/A	3.3E-04	5.5E+00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SLKVC	265	N/A	N/A	N/A	N/A	N/A	N/A	1.4E-04	8.6E+00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SLSVF	271	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.7E-04	8.6E+00	N/A	N/A
SLSVF	272	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.3E-06	7.1E+00	N/A	N/A
SLSVF	273	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.1E-05	9.3E+00	N/A	N/A
SLSVF	274	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.9E-06	1.1E+01	N/A	N/A
SLSVF	275	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.0E-07	3.4E+02	N/A	N/A
SLSVF	276	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.8E-08	2.8E+01	N/A	N/A
SLKHF	281	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.8E-07	1.2E+01
SLKHF	282	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.3E-05	8.8E+00
SLKHF	283	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.9E-07	1.8E+01
SLKHC	284	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.1E-10	3.1E+01
SLKHF	285	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.1E-10	3.1E+01
SLKHF	286	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NEGL	
SLKHF	287	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.5E-10	5.8E+01
SLKHC	288	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NEGL	
SLKHF	289	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NEGL	
SLKHF	2810	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.4E-05	1.2E+01
SLKHF	2811	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.9E-05	7.5E+00
SLKHF	2812	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.2E-07	9.2E+00
SLKHF	2813	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.6E-03	2.3E+01
SLKHF	2814	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.9E-08	2.7E+01
SLKHF	2815	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.6E-10	2.7E+01
SLKHF	2816	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.6E-05	5.2E+00
SLKHF	2817	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.1E-05	9.6E+00

for the warehouses at UMDA. The accident sequence designations are also shown on the Fig. 5-11 event tree. For those accident sequences where no agent release occurs, the release scenario is labeled "NR." Those release scenarios whose frequency is below 1.0×10^{-10} for all sites have been screened using the frequency criterion labeled with an "F" in the event tree. The events modeled in Fig. 5-11 are discussed below:

1. Earthquake Occurs. The initiating event (Event 1) in Fig. 5-11 is earthquake occurrence. To simplify the event tree evaluation, Event 1 further restricts the earthquake intensity to an acceleration range from gl (0.15 to 0.2 g) to gu (>0.7 g). Seven ranges are considered:

   a. 0.15 to 0.2 g.
   b. 0.2 to 0.3 g.
   c. 0.3 to 0.4 g.
   d. 0.4 to 0.5 g.
   e. 0.5 to 0.6 g.
   f. 0.6 to 0.7 g.
   g. Greater than 0.7 g.

   Earthquakes below 0.15 g are not considered in the analysis because the damage probabilities associated with such tremors are negligibly small. Detailed examination of seismic ranges above 0.7 g is unnecessary because earthquakes above 0.7 g have a probability of almost 1.0 of causing damage.

   The initiating event frequency at each site is the site-specific frequency at which earthquakes in the range gl to gu occur.

2. "K" Warehouses Damaged by Earthquake. Warehouse damage is defined as structural collapse. This is the only failure mode of interest because it will crush stored ton containers.

Although less severe damage can result from an earthquake, it was screened in quantifying the Event 2 probability because it does not induce ton container failure.

Three damage combinations are considered in Event 2:

a. No warehouses are damaged (K = 0).

b. Only one warehouse is damaged (K = 1).

c. Both warehouses are damaged (K = 2).

Tracking these three probabilities is necessary in order to estimate the agent release source term. Note that since there is only one warehouse at NAAP, the probability that K = 2 is zero for that site.

Event 2 damage probabilities are based upon a generic study of damage to structures designed to the Uniform Building Code.

3. Munitions Damaged in "L" Warehouses. Event 3 addresses whether the earthquake causes an agent release from the stored munitions. Two failure modes are analyzed: puncture and crushing.

Only ton containers are subject to these failures. Spray tanks are in overpacks which protect them from crush forces. Furthermore, they are not stacked while in storage, hence can't be punctured.

Three damage combinations are considered in Event 3:

a. No agent releases result from the earthquake (L = 0).

b. The earthquake causes an agent release in one warehouse (L = 1).

c. The earthquake causes an agent release in both warehouses (L = 2).

The puncture probability is the probability that at least one ton container falls and strikes a probe of sufficient size and density to penetrate it. The probability that ton containers are crushed is correlated to warehouse damage. If K is 0, 1, or 2 in Event 2, then ton containers in none, 1, or 2 warehouses are crushed, respectively. Since the NAAP site has only one warehouse, the probability that L = 2 is zero for that site. In addition, since only spray tanks are stored in the TEAD warehouses, L can only be zero at that site.

4. <u>Ignition at "M" Warehouses</u>. Seismically initiated fires are an important consideration because they influence agent dispersion and can thermally fail agent containers. This second aspect is particularly important at TEAD because fire damage is the only spray tank container failure mode.

Electrical fires are the only concern in warehouses. The three conditions necessary for an electrical fire are:

a. An electrical fault capable of causing arcing.
b. A supply of electric power to sustain the arc.
c. Contact with an ignition source.

Including this second condition in the fire ignition probability calculation is important because available data indicate that offsite power can be lost at a relatively low seismic intensity.

Condition three considers both the agent and wood dunnage assemblies as possible ignition sources in the warehouses. If ton containers have been damaged by either crush or puncture,

the probability of igniting spilled agent given an electrical arc has occured is essentially unity. If no munition damage has occurred, the probability of ignition is represented as the ratio of exposed wood surface area to the total area of the warehouse.

Similar to previous events, Event 4 addresses how many warehouses experience ignition.

5. Ignition at Warehouse With Damaged Munitions. If the earthquake only damages the containers stored in one warehouse and ignition occurs at only one warehouse, it is necessary to discern whether the fire is in the warehouse with the damaged containers. If the fire is in the same warehouse as the damaged containers, thermal failure and the subsequent release of agent from the second warehouse is averted. However, if the damaged containers and fire are in different warehouses, then the agent release source term will be increased.

Suppression of fires has a negligible probability since the warehouses have no fire alarms nor automatic fire suppression systems. For this reason it is not considered in the warehouse analysis.

5.2.5. Lightning

Munitions stored in igloos and warehouses are protected from lightning. Hence, only ton containers stored outdoors at APG, PBA, and TEAD may be susceptible to lightning strikes. No event tree model has been developed for this scenario. Basically, if a lightning strikes a ton container, the container will be breached and agent will spill to the ground.

A lightning strike density for the contiguous United States was previously determined (Ref. 5-12) based on the correlation developed

from the duration of thunderstorms. Based on this empirical correlation, the frequency (events/yr-km^2) for the different storage locations has been determined, as shown in Table 4-7.

Using conservative assumptions, a threshold lightning energy required to burn through the ton container wall was found to be proportional to the fourth power of the wall thickness as described in the calculation sheets (Ref. 5-2). Neglecting corrosion thinning of the container wall, the maximum value of failure frequency for each cluster of 15 ton containers at PBA is 5.1×10^{-10}, as shown in Table 5-16.

The results indicate that the threshold lightning energy required to burn through the container wall is a strong function of wall thickness. In order to assess the sensitivity of the failure frequency to corrosion, a probability density function for wall thickness was derived by conservatively assuming that one ton container stored outdoors has a leak through its wall. This is a conservative assumption since no wall leak has been reported. This probability density function for wall thickness is used in conjunction with the lightning energy requirements to calculate the failure frequency of a cluster of 21 containers at the different sites. As expected for the PBA site, the failure probability is increased by approximately 55 from the previous value of 5.1×10^{-10}.

If all other agent release scenarios have frequencies that are below this bounding value, then the extent of container corrosion must be investigated. However, if other scenarios involving comparable or larger amounts of agent release also have frequencies much higher than the bounding value for the lightning initiated release, then lightning release scenarios can be ignored. This is true for aircraft crash accidents which lead to much larger releases and also higher frequencies for some sites.

TABLE 5-16
SITE-SPECIFIC LIGHTING STRIKE INFORMATION

Name of Site	Ground Density [1] Event/Yr/km^2 N_1	Projected Area for Each Cluster (21 Container) (km)	Failure Probability Event/Yr-Cluster No Corrosion Effect	Failure Probability Event/Yr-Cluster Corrosion Effect
Aberdeen Proving Ground (APG)	3	2.5×10^{-3}	1.4×10^{-10}	7.65×10^{-9}
Anniston Army Deport (ANAD)	9	2.5×10^{-3}	--	
Laxington - Blue Grass Army Depot (LBAD)	9	2.5×10^{-3}	--	
Newport Army Ammunition Depot (NAAP)	5	2.5×10^{-3}	--	
Pine Bluff Arsenal (PBA)	11	2.5×10^{-3}	5.1×10^{-10}	2.8×10^{-8}
Pueblo Depot Activity (PUDA)	4	2.5×10^{-3}	--	
Tooele Army Deport (TEAD)	3	2.5×10^{-3}	1.4×10^{-10}	7.65×10^{-9}
Umatilla Depot Activity (UMDA)	2	2.5×10^{-3}	--	

5.2.6. Floods

During a flood, materials such as lumber, crates, storage tanks, and other lightweight containers may be carried away by flood flows and cause damage to downstream structures. Water velocities during floods depend largely on the size and shape of the cross sections, conditions of the stream, and the slope bed, all of which vary on different streams and at different locations. In the upper reaches of a flood basin, main channel flows could be as high as 14 ft/s, but typical overbank flow is less than 2 ft/s (Ref. 5-13).

Munitions stored in igloos and warehouses are considered protected against flood-generated projectiles. The only munition stored outdoors are mustard-filled ton containers (APG, PBA, and TEAD).

The puncture equation is as follows:

$$V_m^2 = \{64\ (672\ DT)^{3/2}\}/W \quad , \tag{5-5}$$

where D = probe diameter (in.),
T = wall thickness to be punctured (in.),
W = weight of projectile (i.e., moving object) (lb),
V_m = velocity of projectile (ft/s).

The wall thickness of the ton container is 0.41 in. Assuming the smallest probe size is 0.8-in. in diameter,

$$V_m^2\ (W) = (64)(672\ DT)^{3/2} = 217{,}335 \quad .$$

For puncture, the following conditions must be met:

V_m (ft/s)	W (lb)
1	217,335
2	53,334
6	6,037
10	2,173
14	1,108

A credible flood-generated projectile is assumed to be a light, steel tank with a rigidly attached 0.8-in. diameter probe. This could be a water storage tank or a gasoline tank, using a tank height to diameter ratio of 1.2 and a wall thickness of 0.25 in. Table 5-17 presents the data developed for steel tanks. Tanks larger than 10 ft in diameter would not be credible except in main channel flows. Thus, typical overbank flows, i.e., 2 ft/s, would not produce puncture.

Puncture could be initiated by using an extreme overbank velocity of 6.13 ft/s combined with a 10-ft diameter floating tank with a rigidly attached 0.8-in. probe. The probability of a 6.13 ft/s overbank velocity is estimated to be less than 10%. This condition will be designated as the reference flood-generated projectile.

The probability of puncture of a single ton container from the refernce single floating tank condition is as follows:

$$P_F = L_p \times T_p \times P_p \quad , \qquad (5\text{-}6)$$

where L_p = location probability, i.e., the probability that the probe attached to the floating tank is pointing towards the ton container wall at the moment of collision,

TABLE 5-17
PROBABLE SIZE DISTRIBUTION FOR STEEL TANKS

D Diameter (ft)	1.2D Height (ft)	$57.67D^2$ Weight (lb)	$5.3407D^2$ Surface Area (ft^2)
2	2.4	231	21.36
4	4.8	923	84.45
6	7.2	2076	192.0
8	9.6	3690	342.0
10	12.0	5767	534.0

T_p = target probability, i.e., the probability that the tank collides with the ton container,

P_p = probability of probe being present.

L_p can be approximated by the ratio of total surface area to the effective surface position. Assuming that the probe must be within a 1 ft^2 location, then:

$$L_p = 1/(7.06)^2 \ (5.3407) = 0.0038 \quad .$$

T_p can be approximated by assuming a flood channel width at the point of collision and comparing that to the length of a ton container (82 in.). Using a three-mile wide channel, which is conservative for a typical flood, then:

$$T_p = 82/\{(5280)\ (12)\ (3)\} = 0.00043 \text{ or } 0.0043$$

for the total width of 10 containers.

P_p is estimated to be 1 x 10^{-3}. Thus the probability of a reference tank hitting and rupturing a ton container is

$$P_F = (0.0038)\ (0.0043)\ (0.001) = 1.6 \times 10^{-8} \quad .$$

It would seem reasonable from the flood basin size to assume no more than one reference floating projectile per flood and the flood reoccurrence to be greater than 100 years. In addition, the probability of a 6 ft/s overbank velocity is estimated as 10%. Thus, the probability of rupture is approximately 1.63 x 10^{-11}/yr.

Thus, based on the above calculations this scenario can be screened out on the basis that its frequency is below the criterion.

5.3. SPECIAL HANDLING ACTIVITIES

5.3.1. Leaking Munitions

Several scenarios were identified that specifically address the leakage of stored munitions and the accidents that could occur in the process of isolating leaking munitions which could aggravate the existing situation. The event trees are shown in Figs. 5-12 and 5-13.

Sequence SL1 addresses the possibility that a munition could leak from the time the periodic inspection has been performed until the next periodic inspection. It is assumed that the leaking munition will be detected at the time the next inspection is made. For all sites, except at APG, the inspections are assumed to be performed quarterly (90 days). At APG, the ton containers are inspected daily. No event tree was developed for this scenario since it is represented by a single event failure.

Sequences SL2 and SL9 address accidents related to the movements of munitions for inspection or isolation of leakers. The forklift tine puncture or drop of munition was determined to be largely due to human error. The quantification of these events required a detailed human reliability study (Ref. 5-14). Essentially a task analysis was performed to identify those errors that could potentially impact agent release probabilities. Available data was used to quantify the probabilities of some of these errors and extrapolations were made from these fixed data to quantify the remainder.

Isolation of leaking rockets require special tasks. The leaking rockets are isolated in the storage igloo at the original location, where the pallet containing the leaking rocket is unpacked. Only those rockets blocking access to the leaking rocket are removed and are placed in a holding fixture. This rocket is hand-carried by a two-man team wearing Level A protective clothing to the PIG (which has been placed

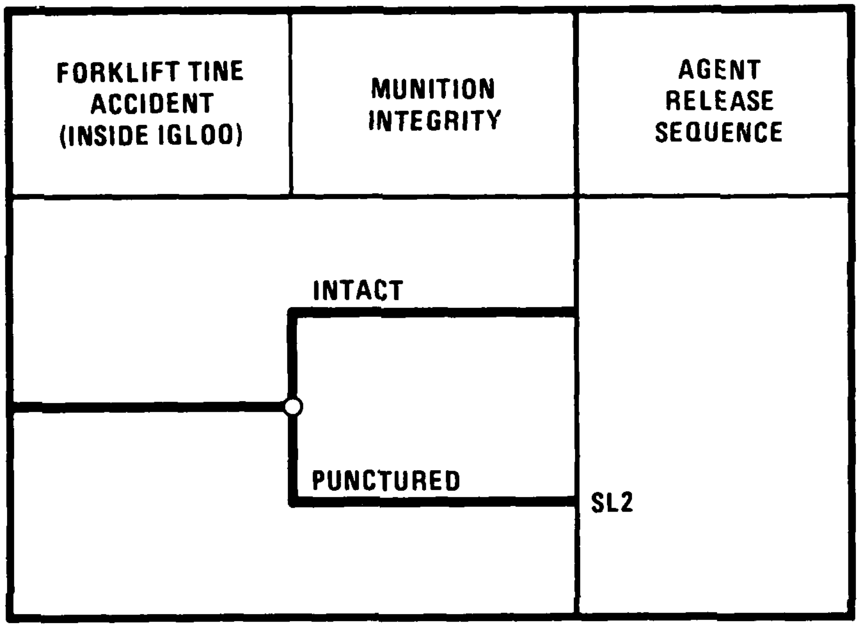


Fig. 5-12. Munition punctured by forklift tine during leaker - handling activities

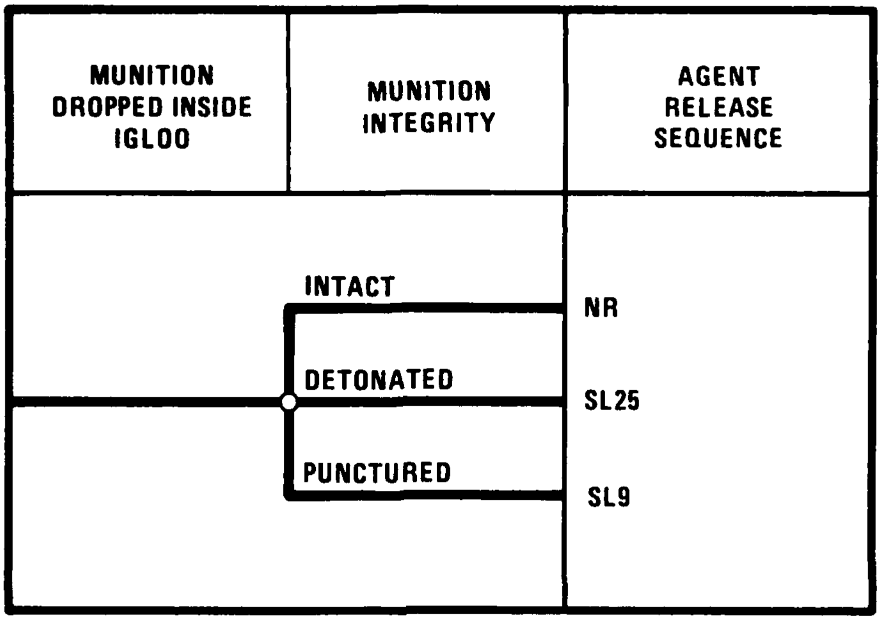


Fig. 5-13. Munition dropped during leaker isolation operation

on a plastic sheet) and secured in it. The handlers lift the decontaminated PIG by its handles, carry it outside, and place it on the truck that will carry it to an igloo reserved for leaking munitions (Ref. 5-1). The analysis assumes that the same procedure is followed for isolating other leaking munitions, except that overpacks (other than PIGs) are used.

Three types of operator errors related to leaker isolation were identified in the task analysis: (1) puncturing a munition with a forklift tine, (2) dropping a munition or pallet from a forklift, and (3) dropping a single munition while hand-carrying it. Details on these handling errors are discussed in Section 6 (Handling Activities).

A previously identified scenario involving the improper replacement of a corroded valve or plug in a ton container (Sequence SL16, Ref. 5-15), has been deleted in the present evaluation. It is expected that few ton containers with GB will require that their valves be replaced before collocation and disposal are initiated. The human reliability analysis (see Appendix J) concluded that this event has a low frequency of occurrence. Furthermore, the amount of mustard or VX that could be dispersed to the atmosphere from a valve or plug replacement operation is insignificant.

Table 5-18 presents the data used to evaluate the accident frequencies for the scenarios addressed above. The frequency of scenario SL1 was derived by determining the leakage rate for each munition type based on the leaker data at each site and the total munition inventory at each site. Since the two parameters are classified information, they will be presented and discussed further in a classified appendix.

TABLE 5-18
DATA BASE FOR ANALYSIS OF SEQUENCES SL1, SL2, AND SL9

Event	Frequency of Probability	Reference
Munition develops a leak during storage (Scenario SL1):		
Bomb (TEAD)	7.5E-5 per year	Ref. 5-16
(UMDA)	4.5E-4 per year	
4.2-in. mortar (ANAD)	2.8E-7 per year	
(PUDA)	1.0E-6 per year	
(TEAD)	7.0E-6 per year	
105-mm cartridge (ANAD)	2.8E-7 per year	
(PUDA)	1.0E-6 per year	
(TEAD)	7.0E-6 per year	
Ton container		
Mine (ANAD)	9.0E-6 per year	
(PBA)	1.1E-6 per year	
(TEAD)	2.5E-4 per year	
(UMDA)	3.1E-4 per year	
Projectile (ANAD)	4.9E-6 per year	
(LBAD)	9.3E-6 per year	
(PUDA)	5.0E-6 per year	
(TEAD)	8.1E-5 per year	
(UMDA)	6.2E-5 per year	
Rocket (ANAD)	6.1E-5 per year	
(LBAD)	4.3E-5 per year	
(PBA)	9.1E-7 per year	
(TEAD)	1.3E-3 per year	
(UMDA)	1.8E-4 per year	
Spray tank	9.8E-5 per year	
Forklift tine accident (SL2)	1.0E-4 per operator	Ref. 5-15
Munition puncture given tine accident:		
Bomb	1.29E-2	Ref. 5-2
4.2-in. mortar	3.68E-2	
105-mm cartridge	8.90E-3	
Mine	7.07E-2	

TABLE 5-18 (Continued)

Event	Frequency of Probability	Reference
Projectile	5.00E-2	
Rocket	2.63E-1	
Spray tank	1.53E-2	
Munition dropped during leaker isolation (SL9):		
Pallet and bulk (B, S)	3.0E-4	Human Reliability
Single (C, D, M, P, Q, R)	6.0E-4	Analysis (Ref. 5-15)
Ton container (K)	3.0E-5	
Munition punctured given drop:		
Bomb (pallet)	4.72E-4	Ref. 5-2
(single)	1.62E-4	
4.2-in. mortar (pallet)	1.24E-4	
(single)	0.0	
105-mm cartridge (pallet)	2.71E-5	
(single)	0.0	
Ton continer	1.55E-3	
Mine (pallet)	9.27E-5	
(single)	4.08E-5	
Projectile (pallet or single)	0.0	
Munition detonates given 6 ft drop	1.6E-8/munition	Ref. 5-2

5.4. SCENARIO QUANTIFICATION

Tables 5-19 and 5-20 present the results of the accident scenario frequency analysis for all the storage sequences discussed previously except those which were initially screened (i.e., SL10, SL11, SL12, SL13, and SL14). From the results it is evident that the following sequences could be screened out further based on the 1.0×10^{-10}/yr criterion:

SL17	- Large aircraft direct crash; fire contained in 30 min.
SL21	- Large aircraft indirect crash; fire contained in 30 min.
SL23	- Tornado-generated missiles cause munition detonation upon impact.
SR7, SA7, SW7	- Tornado-generated missile penetrate munitions in OFCs (SR, SA) or barge packages (SW); no detonations occur.
SR8, SA8	- Tornado-generated missile penetrates munitions in OFCs and cause munition detonations.

Since handling-related accidents are given in terms of events per munition operation, no screening can be performed without divulging classified information.

File: CONSTOR.WK1 date21-Aug-87 page 1

TABLE 5-19
FREQUENCIES OF STORAGE ACCIDENT SEQUENCES (SL)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SL1 - Munition develops a leak during the between-inspections period.																	
SLBGC	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	7.5E-05	1.0E+01	4.5E-04	1.0E+01
SLDHC	1	2.8E-07	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.0E-06	1.0E+01	7.0E-06	1.0E+01	N/A	-
SLCGC	1	2.8E-07	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	7.0E-06	1.0E+01	N/A	-
SLCHC	1	2.8E-07	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.0E-06	1.0E+01	N/A	-	N/A	-
SLKGC (IGL)	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.9E-04	1.0E+01	N/A	-
SLKHC (60' IGL)	1	5.9E-06	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLKHS (OPEN)	1	N/A	-	N/A	-	N/A	-	N/A	-	5.9E-06	1.0E+01	N/A	-	5.9E-06	1.0E+01	N/A	-
SLKHS (OPEN)	1	N/A	-	5.9E-06	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLKHC (WH)	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.9E-06	1.0E+01
SLKVC (80' IGL)	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.9E-06	1.0E+01	N/A	-
SLKVC (WH)	1	N/A	-	N/A	-	N/A	-	5.9E-06	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC	1	9.0E-06	1.0E+01	N/A	-	N/A	-	N/A	-	1.1E-06	1.0E+01	N/A	-	2.5E-04	1.0E+01	3.1E-04	1.0E+01
SLPGC	1	4.9E-06	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	8.1E-05	1.0E+01	6.2E-05	1.0E+01
SLPHC	1	4.9E-06	1.0E+01	N/A	-	9.3E-06	1.0E+01	N/A	-	N/A	-	5.0E-06	1.0E+01	8.1E-05	1.0E+01	N/A	-
SLPVC	1	4.9E-06	1.0E+01	N/A	-	9.3E-06	1.0E+01	N/A	-	N/A	-	N/A	-	8.1E-05	1.0E+01	6.2E-05	1.0E+01
SLQGC	1	4.9E-06	1.0E+01	N/A	-	9.3E-06	1.0E+01	N/A	-	N/A	-	N/A	-	8.1E-05	1.0E+01	6.2E-05	1.0E+01
SLQVC	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	8.1E-05	1.0E+01	6.2E-05	1.0E+01
SLRGC	1	6.1E-05	1.0E+01	N/A	-	4.3E-05	1.0E+01	N/A	-	9.1E-07	1.0E+01	N/A	-	1.3E-03	1.0E+01	1.8E-04	1.0E+01
SLRVC	1	6.1E-05	1.0E+01	N/A	-	4.3E-05	1.0E+01	N/A	-	9.1E-07	1.0E+01	N/A	-	1.3E-03	1.0E+01	1.8E-04	1.0E+01
SLSVC	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-05	1.0E+01
SLSVC (WH)	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-05	1.0E+01	N/A	-
SL2 - Munition punctured by forklift tine during leaker handling activities.																	
SLBGC	2	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.2E-06	1.3E+01	5.2E-06	1.3E+01
SLDHC	2	4.4E-05	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	4.4E-05	1.3E+01	4.4E-05	1.3E+01	N/A	-
SLCGC	2	1.1E-05	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-05	1.3E+01	N/A	-
SLCHC	2	1.1E-05	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-05	1.3E+01	N/A	-	N/A	-
SLKGC	2	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 2

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLKHC	2	0.0E+00	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	0.0E+00	-	0.0E+00	-
SLKVC	2	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	N/A	-
SLMVC	2	8.5E-05	1.3E+01	N/A	-	N/A	-	N/A	-	8.5E-05	1.3E+01	N/A	-	8.5E-05	1.3E+01	8.5E-05	1.3E+01
SLFGC	2	6.0E-05	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.0E-05	1.3E+01	6.0E-05	1.3E+01
SLFHC	2	6.0E-05	1.3E+01	N/A	-	6.0E-05	1.3E+01	N/A	-	N/A	-	6.0E-05	1.3E+01	6.0E-05	1.3E+01	N/A	-
SLPVC	2	6.0E-05	1.3E+01	N/A	-	6.0E-05	1.3E+01	N/A	-	N/A	-	N/A	-	6.0E-05	1.3E+01	6.0E-05	1.3E+01
SLGGC	2	6.0E-05	1.3E+01	N/A	-	6.0E-05	1.3E+01	N/A	-	N/A	-	N/A	-	6.0E-05	1.3E+01	6.0E-05	1.3E+01
SLQVC	2	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.0E-05	1.3E+01	6.0E-05	1.3E+01
SLRGC	2	3.2E-04	1.3E+01	N/A	-	3.2E-04	1.3E+01	N/A	-	3.2E-04	1.3E+01	N/A	-	3.2E-04	1.3E+01	3.2E-04	1.3E+01
SLRVC	2	3.2E-04	1.3E+01	N/A	-	3.2E-04	1.3E+01	N/A	-	3.2E-04	1.3E+01	N/A	-	3.2E-04	1.3E+01	3.2E-04	1.3E+01
SLSVC	2	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.6E-06	1.3E+01	4.6E-06	1.3E+01
SL4 - Large aircraft direct crash onto storage area; fire not contained in 30 minutes (burstered munitions detonate if hit).																	
SLBGF (80' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01
SLBGF (89' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-
SLDHC (60' IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLDHC (80' IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-09	1.0E+01	9.8E-12	1.0E+01	N/A	-
SLDHC (89' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-
SLCGC (60' IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLCGC (80' IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	-	N/A	-
SLCGC (89' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-11	-	N/A	-
SLCHC (60' IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLCHC (80' IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-09	1.0E+01	N/A	1.0E+01	N/A	-
SLCHC (89' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	1.0E+01	N/A	-
SLKGF (80' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	N/A	
SLKHF (60' IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	
SLKHF (OFEN)	4	N/A	-	1.1E-09	1.0E+01	N/A	-	N/A	-	7.6E-09	1.0E+01	N/A	-	3.5E-09	1.0E+01	N/A	-
SLKHF (WH)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-08	1.0E+01
SLKVF (80' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	N/A	-

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 3

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLKVF (WH)	4	N/A	-	N/A	-	N/A	-	1.6E-09	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC (60' IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC (80' IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	4.1E-11	1.0E+01	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01
SLFGC (60' IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLFGC (80' IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01
SLFGC (89' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-
SLFHC (60' IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLFHC (80' IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-09	1.0E+01	9.8E-12	1.0E+01	N/A	-
SLFHC (89' IGL)	4	N/A	-	N/A	-	1.3E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-
SLPVC (60' IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLPVC (80' IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01
SLPVC (89' IGL)	4	N/A	-	N/A	-	1.3E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-
SLQGC (60' IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLQGC (80' IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01
SLQGC (89' IGL)	4	N/A	-	N/A	-	1.3E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-
SLQVC (60' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLQVC (80' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01
SLQVC (89' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-
SLRGC (60' IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLRGC (80' IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	4.1E-11	1.0E+01	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01
SLRGC (89' IGL)	4	N/A	-	N/A	-	1.3E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-
SLRVC (60' IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLRVC (80' IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	4.1E-11	1.0E+01	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01
SLRVC (89' IGL)	4	N/A	-	N/A	-	1.3E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-
SLSVF (80' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.1E-10	1.0E+01
SLSVF (WH)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.9E-10	1.0E+01	N/A	-
SL5 - Large aircraft indirect crash onto storage area; fire not contained in 30 minutes (burstered munitions detonate if hit).																	
SLRGF (80' IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 4

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLBGF (89 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-
SLDHC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLDHC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	4.4E-10	1.3E+01	2.7E-12	1.3E+01	N/A	-
SLDHC (89 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-
SLEGC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLEGC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	-	N/A	-
SLEGC (89 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	-	N/A	-
SLCHC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLCHC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	4.4E-10	1.3E+01	N/A	1.3E+01	N/A	-
SLCHC (89 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	1.3E+01	N/A	-
SLKGF (80 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-
SLKHF (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLKHF (OPEN)	5	N/A	-	2.1E-09	1.0E+01	N/A	-	N/A	-	7.9E-09	1.0E+01	N/A	-	2.7E-12	1.0E+01	N/A	-
SLKHF (WH)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.4E-08	1.1E+01
SLKVF (80 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-
SLKVF (WH)	5	N/A	-	N/A	-	N/A	-	3.8E-09	1.1E+01	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.3E+01	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01
SLFGC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLFGC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01
SLFGC (89 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-
SLFHC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLFHC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	4.4E-10	1.3E+01	2.7E-12	1.3E+01	N/A	-
SLFHC (89 IGL)	5	N/A	-	N/A	-	3.4E-11	1.3E+01	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-
SLFVC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLFVC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01
SLFVC (89 IGL)	5	N/A	-	N/A	-	3.4E-11	1.3E+01	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-
SLQGF (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 5

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLQGC (80' IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01
SLQGC (89' IGL)	5	N/A	-	N/A	-	3.4E-11	1.3E+01	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-
SLQVC (60' IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLQVC (80' IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01
SLQVC (89 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-
SLRGC (60' IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLRGC (80' IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.3E+01	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01
SLRGC (89' IGL)	5	N/A	-	N/A	-	3.4E-11	1.3E+01	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-
SLRVC (60' IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLRVC (80' IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.3E+01	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01
SLRVC (89' IGL)	5	N/A	-	N/A	-	3.4E-11	1.3E+01	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-
SLSVF (80' IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-10	1.3E+01
SLSVF (WH)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.0E-10	1.1E+01	N/A	-
SL6 - Tornado generated missiles strike the storage magazine, warehouse, or open storage area; munitions breached (no detonation).																	
SLBGC	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.5E-15	9.4E+01	1.2E-15	9.4E+01
SLDHC	6	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-13	9.4E+01	5.8E-15	9.4E+01	N/A	-
SLCGC	6	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.8E-15	9.4E+01	N/A	-
SLCHC	6	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-13	9.4E+01	N/A	-	N/A	-
SLKGC (80' IGL)	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.4E-15	9.4E+01	N/A	-
SLKHC (60' IGL)	6	1.2E-12	9.4E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLKHS (OPEN)	6	N/A	-	6.6E-11	9.4E+01	N/A	-	N/A	-	9.9E-10	9.4E+01	N/A	-	1.2E-12	9.4E+01	N/A	-
SLKHC (WH)	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.9E-13	9.4E+01
SLKVC (80' IGL)	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.4E-15	9.4E+01	N/A	-
SLKVC (WH)	6	N/A	-	N/A	-	N/A	-	3.3E-10	9.4E+01	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC	6	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	8.3E-12	9.4E+01	N/A	-	1.3E-14	9.4E+01	5.8E-15	9.4E+01
SLFGC	6	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.8E-15	9.4E+01	5.8E-15	9.4E+01
SLFHC	6	4.8E-12	9.4E+01	N/A	-	4.8E-12	9.4E+01	N/A	-	N/A	-	3.2E-13	9.4E+01	5.8E-15	9.4E+01	N/A	-
SLFVC	6	4.8E-12	9.4E+01	N/A	-	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	5.8E-15	9.4E+01	5.8E-15	9.4E+01

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 6

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLQGC	6	4.8E-12	9.4E+01	N/A	-	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	5.8E-15	9.4E+01	5.8E-15	9.4E+01
SLQVC	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.8E-15	9.4E+01	5.8E-15	9.4E+01
SLFGC	6	4.8E-12	9.4E+01	N/A	-	4.8E-12	9.4E+01	N/A	-	1.9E-11	9.4E+01	N/A	-	4.8E-14	9.4E+01	5.6E-15	9.4E+01
SLRVC	6	4.8E-12	9.4E+01	N/A	-	4.8E-12	9.4E+01	N/A	-	1.9E-11	9.4E+01	N/A	-	4.8E-14	9.4E+01	5.8E-15	9.4E+01
SLSVC (80' IGL)	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.5E-15	9.4E+01
SLSVC (WH)	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-13	9.4E+01	N/A	-
SL7 - Severe earthquake breaches the munitions in storage igloo; no detonations.																	
SLPGC	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-06	1.3E+01	7.0E-08	1.3E+01
SLDHC	7	3.0E-08	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	3.0E-08	1.3E+01	7.0E-07	1.3E+01	N/A	-
SLCGC	7	7.0E-09	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-07	1.3E+01	N/A	-
SLCHC	7	7.0E-09	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	7.0E-09	1.3E+01	N/A	-	N/A	-
SLHGC (80' IGL)	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-05	1.3E+01	N/A	-
SLHHC (60' IGL)	7	4.6E-07	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLHHS (OPEN)	7	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-
SLHHC (WH)	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLHVC (80' IGL)	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-05	1.3E+01	N/A	-
SLHVC (WH)	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC	7	1.8E-08	1.3E+01	N/A	-	N/A	-	N/A	-	1.8E-08	1.3E+01	N/A	-	4.1E-07	1.3E+01	1.8E-08	1.3E+01
SLFGC	7	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-
SLFHC	7	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	N/A	-
SLFVC	7	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	
SLQGC	7	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	
SLQVC	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-
SLRGC	7	9.7E-08	1.3E+01	N/A	-	9.7E-08	1.3E+01	N/A	-	9.7E-08	1.3E+01	N/A	-	2.1E-06	1.3E+01	9.7E-08	1.3E+01
SLRVC	7	9.7E-08	1.3E+01	N/A	-	9.7E-08	1.3E+01	N/A	-	9.7E-08	1.3E+01	N/A	-	2.1E-06	1.3E+01	9.7E-08	1.3E+01
SLSVC (80' IGL)	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-
SLSVC (WH)	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SL8 - Meteorite strikes the storage area; fire occurs; munitions breached (if burstered detonation occurs)																	

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 7

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLBGF	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01
SLDHC	8	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01	N/A	-
SLCGC	8	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	N/A	-
SLCHC	8	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	N/A	-	N/A	-
SLKGF (IGL)	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	N/A	-
SLKHF (IGL)	8	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLKHF (OPEN)	8	N/A	-	1.2E-11	1.7E+01	N/A	-	N/A	-	1.2E-11	1.7E+01	N/A	-	1.2E-11	1.7E+01	N/A	
SLKHF (WH)	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-10	2.6E+01
SLKVF (IGL)	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	N/A	-
SLKVF (WH)	8	N/A	-	N/A	-	N/A	-	1.0E-09	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	
SLMVC	8	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01
SLPGC	8	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01
SLPHC	8	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01	N/A	-
SLPVC	3	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01
SLQGC	8	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01
SLQVC	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01
SLRGC	9	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01
SLRVC	9	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01
SLSVF (IGL)	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01
SLSVF (WH)	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.7E-09	2.6E+01	N/A	-
SL9 - Munition dropped during leaker isolation activities.																	
SLBGC	9	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.6E-07	1.3E+01	6.6E-07	1.3E+01
SLDHC	9	4.5E-07	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	4.5E-07	1.3E+01	4.5E-07	1.3E+01	N/A	
SLCGC	9	9.8E-08	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-08	1.3E+01	N/A	
SLCHC	9	9.8E-08	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-08	1.3E+01	N/A	-	N/A	
SLKGC	9	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.9E-07	1.3E+01	N/A	-
SLKHC	9	1.9E-07	1.3E+01	1.9E-07	1.3E+01	N/A	-	N/A	-	1.9E-07	1.3E+01	N/A	-	1.9E-07	1.3E+01	1.9E-07	1.3E+01
SLKVC	9	N/A	-	N/A	-	N/A	-	1.9E-07	1.3E+01	N/A	-	N/A	-	1.9E-07	1.3E+01	N/A	

See notes at end of table.

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLMVC	9	3.6E-07	1.3E+01	N/A	-	N/A	-	N/A	-	3.6E-07	1.3E+01	N/A	-	3.6E-07	1.3E+01	3.6E-07	1.3E+01
SLFGC	9	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-
SLFHC	9	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	N/A	-
SLFVC	9	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-
SLQGC	9	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-
SLQVC	9	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-
SLRSC	9	1.5E-06	1.3E+01	N/A	-	1.5E-06	1.3E+01	N/A	-	1.5E-06	1.3E+01	N/A	-	1.5E-06	1.3E+01	1.5E-06	1.3E+01
SLRVC	9	1.5E-06	1.3E+01	N/A	-	1.5E-06	1.3E+01	N/A	-	1.5E-06	1.3E+01	N/A	-	1.5E-06	1.3E+01	1.5E-06	1.3E+01
SLSVC	9	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.6E-06	1.3E+01	3.6E-06	1.3E+01
SL15 - Small aircraft direct crash onto warehouse or open storage yard; fire not contained in 30 minutes.																	
SLHGF (IGL)	15	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-
SLHHF (IGL)	15	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLHHF (OPEN)	15	N/A	-	1.6E-05	1.0E+01	N/A	-	N/A	-	5.6E-07	1.0E+01	N/A	-	1.4E-07	1.0E+01	N/A	-
SLHHF (WH)	15	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	8.9E-09	1.0E+01
SLHVF (IGL)	15	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-
SLHVF (WH)	15	N/A	-	N/A	-	N/A	-	8.1E-09	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-
SLSVF (IGL)	15	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLSVF (WH)	15	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-08	1.0E+01	N/A	-
SL16 - Large aircraft direct crash; no fire. (burstered munitions detonate)																	
SLRGC (80' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01
SLRGC (89 IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-
SLDHC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLDHC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.0E-09	1.0E+01	1.2E-11	1.0E+01	N/A	-
SLDHC (89 IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-
SLEGC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLEGC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	-	N/A	-
SLEGC (89 IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.3E-11	-	N/A	-
SLEHC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 9

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLCHC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.0E-09	1.0E+01	N/A	1.0E+01	N/A	-
SLCHC (89' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	1.0E+01	N/A	-
SLKGC (80' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	N/A	-
SLKHC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLKHS (OPEN)	16	N/A	-	1.3E-09	1.0E+01	N/A	-	N/A	-	9.4E-09	1.0E+01	N/A	-	4.3E-09	1.0E+01	N/A	-
SLKHS (WH)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.4E-08	1.0E+01
SLKVC (80' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	N/A	-
SLKVS (WH)	16	N/A	-	N/A	-	N/A	-	2.0E-09	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	5.0E-11	1.0E+01	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01
SLPGC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLPGC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01
SLPGC (89' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-
SLPHC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLPHC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.0E-09	1.0E+01	1.2E-11	1.0E+01	N/A	-
SLPHC (89' IGL)	16	N/A	-	N/A	-	N/A	1.0E+01	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-
SLPVC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLPVC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01
SLPVC (89' IGL)	16	N/A	-	N/A	-	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-
SLQGC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLQGC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01
SLQGC (89' IGL)	16	N/A	-	N/A	-	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-
SLQVC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLQVC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01
SLQVC (89' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-
SLRGC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLRGC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	5.0E-11	1.0E+01	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01
SLRGC (89' IGL)	16	N/A	-	N/A	-	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 10

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLRVC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLRVC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	5.0E-11	1.0E+01	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01
SLRVC (89' IGL)	16	N/A	-	N/A	-	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-
SLSVC (80' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.0E-10	1.0E+01
SLSVS (WH)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.8E-10	1.0E+01	N/A	-
SL17 - large aircraft direct crash; fire contained within 30 minutes. (Applies to non-burstered munitions only)																	
SLKHF (OPEN)	17	N/A	-	3.7E-13	1.0E+01	N/A	-	N/A	-	2.6E-12	1.0E+01	N/A	-	1.2E-12	1.0E+01	N/A	-
SLKHF (WH)	17	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.8E-12	1.0E+01
SLKVF (WH)	17	N/A	-	N/A	-	N/A	-	5.6E-13	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-
SLSVF (WH)	17	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.3E-13	1.0E+01	N/A	-
SL18 - Small aircraft direct crash onto warehouse or open storage yard; no fire.																	
SLKHS (OPEN)	18	N/A	-	2.0E-05	1.0E+01	N/A	-	N/A	-	6.9E-07	1.0E+01	N/A	-	1.7E-07	1.0E+01	N/A	-
SLKHS (WH)	18	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-08	1.0E+01
SLKVS (WH)	18	N/A	-	N/A	-	N/A	-	1.0E-08	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-
SLSVS (WH)	18	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.9E-08	1.0E+01	N/A	-
SL19 - Small aircraft direct crash onto warehouse or open storage yard; fire contained in 30 minutes.																	
SLKHF (OPEN)	19	N/A	-	3.0E-07	1.3E+01	N/A	-	N/A	-	1.1E-08	1.3E+01	N/A	-	2.7E-09	1.3E+01	N/A	-
SLKHF (WH)	19	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.0E-10	1.3E+01
SLKVF (WH)	19	N/A	-	N/A	-	N/A	-	1.5E-10	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-
SLSVF (WH)	19	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.0E-10	1.3E+01	N/A	-
SL20 - Large aircraft indirect crash onto storage area; no fire.																	
SLBGC (80' IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01
SLBGC (89' IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-
SLDHC (60' IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLDHC (80' IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	5.4E-10	1.3E+01	3.3E-12	1.3E+01	N/A	-
SLDHC (89' IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-
SLCGC (60' IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLCGC (80' IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	-	N/A	-

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 11

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLCGC (89 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.4E-12	-	N/A	-
SLCHC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLCHC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	5.4E-10	1.3E+01	N/A	1.3E+01	N/A	-
SLCHC (89 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	1.3E+01	N/A	-
SLKGC (80 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	N/A	-
SLKHC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLKHS (OPEN)	20	N/A	-	2.6E-09	1.0E+01	N/A	-	N/A	-	9.7E-09	1.0E+01	N/A	-	3.5E-09	1.0E+01	N/A	-
SLKHC (WH)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.7E-08	1.1E+01
SLKVC (80 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	N/A	-
SLKVC (WH)	20	N/A	-	N/A	-	N/A	-	4.7E-09	1.1E+01	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	1.4E-11	1.3E+01	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01
SLFGC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLFGC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01
SLFGC (89 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-
SLFHC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLFHC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	5.4E-10	1.3E+01	3.3E-12	1.3E+01	N/A	-
SLFHC (89 IGL)	20	N/A	-	N/A	-	4.2E-11	1.3E+01	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-
SLFVC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLFVC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01
SLFVC (89 IGL)	20	N/A	-	N/A	-	4.2E-11	1.3E+01	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-
SLQGC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLQGC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01
SLQGC (89 IGL)	20	N/A	-	N/A	-	4.2E-11	1.3E+01	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-
SLQVC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLQVC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01
SLQVC (89 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-
SLRGC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 12

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLRGC (80' IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	1.4E-11	1.3E+01	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01
SLRGC (89' IGL)	20	N/A	-	N/A	-	4.2E-11	1.3E+01	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-
SLRVC (60' IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLRVC (80' IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	1.4E-11	1.3E+01	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01
SLRVC (89' IGL)	20	N/A	-	N/A	-	4.2E-11	1.3E+01	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-
SLSVC (80' IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.4E-10	1.3E+01
SLSVC (WH)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	7.4E-10	1.1E+01	N/A	-
SL21 - large aircraft indirect crash onto storage area; fire contained in 30 minutes																	
SLRGF (80' IGL)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.2E-16	-	0.0E+00	-
SLBGF (89' IGL)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.3E-16	-	N/A	-
SLKGF (80' IGL)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.2E-16	-	N/A	-
SLKHF (60' IGL)	21	1.9E-14	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLKHF (OPEN)	21	N/A	-	7.2E-13	1.0E+01	N/A	-	N/A	-	2.7E-12	1.0E+01	N/A	-	9.7E-13	1.0E+01	N/A	-
SLKHF (WH)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.8E-12	1.1E+01
SLKVF (80' IGL)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.2E-16	1.3E+01	N/A	-
SLKVF (WH)	21	N/A	-	N/A	-	N/A	-	1.3E-12	1.1E+01	N/A	-	N/A	-	N/A	-	N/A	-
SLSVF (80' IGL)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-
SLSVF (WH)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.1E-13	1.1E+01	N/A	-
SL22 - Severe earthquake leads to munition detonation																	
SLBGC	22	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	
SLDHC	22	1.2E-08	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-08	2.6E+01	2.7E-07	2.6E+01	N/A	-
SLCGC	22	6.2E-07	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.4E-07	2.6E+01	N/A	-
SLCHC	22	6.2E-07	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	6.2E-07	2.6E+01	N/A	-	N/A	-
SLKGS (IGL)	22	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-
SLKHS (IGL)	22	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLKHS (OPEN)	22	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-
SLKHS (WH)	22	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-
SLKVS (IGL)	22	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 13

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLKVS (WH)	22	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC	22	7.0E-09	2.6E+01	N/A	-	N/A	-	N/A	-	7.0E-09	2.6E+01	N/A	-	1.6E-07	2.6E+01	7.0E-09	2.6E+01
SLFGC	22	4.7E-09	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.0E-07	2.6E+01	4.7E-09	2.6E+01
SLFHC	22	4.7E-09	2.6E+01	N/A	-	4.7E-09	2.6E+01	N/A	-	N/A	-	4.7E-09	2.6E+01	1.0E-07	2.6E+01	N/A	-
SLFVC	22	4.7E-09	2.6E+01	N/A	-	4.7E-09	2.6E+01	N/A	-	N/A	-	N/A	-	1.0E-07	2.6E+01	4.7E-09	2.6E+01
SLQGC	22	3.4E-09	2.6E+01	N/A	-	3.4E-09	2.6E+01	N/A	-	N/A	-	N/A	-	7.6E-08	2.6E+01	3.4E-09	2.6E+01
SLQVC	22	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	7.6E-08	2.6E+01	3.4E-09	2.6E+01
SLRGC	22	3.9E-09	2.6E+01	N/A	-	3.9E-09	2.6E+01	N/A	-	3.9E-09	2.6E+01	N/A	-	8.9E-08	2.6E+01	3.9E-09	2.6E+01
SLRVC	22	3.9E-09	2.6E+01	N/A	-	3.9E-09	2.6E+01	N/A	-	3.9E-09	2.6E+01	N/A	-	8.9E-08	2.6E+01	3.9E-09	2.6E+01
SLSVF (IGL)	22	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-
SLSVF (WH)	22	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-
SL23 - Tornado generated missiles strike the storage igloo and cause munition detonation.																	
SLBGS	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-
SLDHC	23	3.4E-13	9.9E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.2E-14	9.9E+01	3.2E-16	9.9E+01	N/A	-
SLCGC	23	3.4E-13	9.9E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-16	9.9E+01	N/A	-
SLCHC	23	3.4E-13	9.9E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.2E-14	9.9E+01	N/A	-	N/A	-
SLFGS (IGL)	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-
SLKHS (IGL)	23	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
SLKHS (OPEN)	23	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-
SLKHS (WH)	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-
SLKVS (IGL)	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-
SLKVS (WH)	23	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-
SLMVC	23	3.4E-13	9.9E+01	N/A	-	N/A	-	N/A	-	4.6E-13	9.9E+01	N/A	-	7.4E-16	9.9E+01	4.0E-16	9.9E+01
SLFGC	23	3.4E-13	9.9E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-16	9.9E+01	4.0E-16	9.9E+01
SLFHC	23	3.4E-13	9.9E+01	N/A	-	3.4E-13	9.9E+01	N/A	-	N/A	-	2.2E-14	9.9E+01	3.2E-16	9.9E+01	N/A	-
SLFVC	23	3.4E-13	9.9E+01	N/A	-	3.4E-13	9.9E+01	N/A	-	N/A	-	N/A	-	3.2E-16	9.9E+01	4.0E-16	9.9E+01
SLQGC	23	3.4E-13	9.9E+01	N/A	-	3.4E-13	9.9E+01	N/A	-	N/A	-	N/A	-	3.2E-16	9.9E+01	4.0E-16	9.9E+01
SLQVC	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-16	9.9E+01	4.0E-16	9.9E+01

See notes at end of table.

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
SLRGC	23	3.4E-13	9.9E+01	N/A	-	3.4E-13	9.9E+01	N/A	-	1.1E-12	9.9E+01	N/A	-	2.6E-15	9.9E+01	4.0E-16	9.9E+01
SLRVC	23	3.4E-13	9.9E+01	N/A	-	3.4E-13	9.9E+01	N/A	-	1.1E-12	9.9E+01	N/A	-	2.6E-15	9.9E+01	4.0E-16	9.9E+01
SLSVS (IGL)	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-
SLSVS (NH)	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-
SL24 - Lightning strikes ton containers stored outdoors.																	
SLKHS (OPEN)	24	N/A	-	1.4E-10	1.0E+01	N/A	-	N/A	-	5.1E-10	1.0E+01	N/A	-	1.4E-10	1.0E+01	N/A	-
SL25 - Munitions dropped during leaker isolation; munition detonates.																	
SLBGC	25	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-
SLDHC	25	1.7E-07	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.7E-07	2.6E+01	1.7E-07	2.6E+01	N/A	-
SLCGC	25	8.9E-08	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	8.9E-08	2.6E+01	N/A	-
SLCHC	25	8.9E-08	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	8.9E-08	2.6E+01	N/A	-	N/A	-
SLKGC	25	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-
SLKHC	25	0.0E+00	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-
SLKVC	25	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	N/A	-
SLMVC	25	1.3E-07	2.6E+01	N/A	-	N/A	-	N/A	-	1.3E-07	2.6E+01	N/A	-	1.3E-07	2.6E+01	1.3E-07	2.6E+01
SLFGC	25	3.2E-08	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-08	2.6E+01	3.2E-08	2.6E+01
SLFHC	25	3.2E-08	2.6E+01	N/A	-	3.2E-08	2.6E+01	N/A	-	N/A	-	3.2E-08	2.6E+01	3.2E-08	2.6E+01	N/A	-
SLFVC	25	3.2E-08	2.6E+01	N/A	-	3.2E-08	2.6E+01	N/A	-	N/A	-	N/A	-	3.2E-08	2.6E+01	3.2E-08	2.6E+01
SLQGC	25	3.2E-08	2.6E+01	N/A	-	3.2E-08	2.6E+01	N/A	-	N/A	-	N/A	-	3.2E-08	2.6E+01	3.2E-08	2.6E+01
SLQVC	25	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-08	2.6E+01	3.2E-08	2.6E+01
SLFGC	25	5.7E-08	2.6E+01	N/A	-	5.7E-08	2.6E+01	N/A	-	5.7E-08	2.6E+01	N/A	-	5.7E-08	2.6E+01	5.7E-08	2.6E+01
SLRVC	25	5.7E-08	2.6E+01	N/A	-	5.7E-08	2.6E+01	N/A	-	5.7E-08	2.6E+01	N/A	-	5.7E-08	2.6E+01	5.7E-08	2.6E+01
SLSVC	25	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-

NOTES:

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 15

TABLE 5-19 (Continued)

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR

1. Frequency units for scenario 1 are events per munition year.

2. Frequency units for scenarios 2, 9, and 25 are events per leaker.

3. Frequency units for scenarios 4, 5, 8, 15 through 21, and 23 are events per storage unit-year (igloo or warehouse). For ton containers stored outdoors, frequency units for scenarios 8 and 24 are events per cluster-year of ton containers (15 TC/cluster).

4. Agent release for SLFHS 1 (open) assumes outdoor spill onto a porous surface.

5. Frequency units for scenarios 7 and 22 are events per year.

File: STORHOLD.WK1 Page 1 Date 21-Aug-87

TABLE 5-20
FREQUENCY OF INTERIM STORAGE SEQUENCES (SA, SR, SW)

INTERIM STORAGE AIR OPTION (EVENTS/YR)

Scenario	No.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR
Large aircraft crash onto containers; no fire																	
SAFHS	1	N/A	--	6.0E-10	10	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	10	N/A	--
SAFHC	1	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	3.3E-09	10	N/A	--
SAFVC	1	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	3.3E-09	10	N/A	--
SAOGC	1	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	3.3E-09	10	N/A	--
SARGC	1	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	3.3E-09	10	N/A	--
SARVC	1	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	3.3E-09	10	N/A	--
Large aircraft crash onto containers; fire not contained																	
SAFHF	2	N/A	--	3.2E-10	10	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-09	10	N/A	--
SAFHC	2	N/A	--	N/A	--	1.7E-09	10	N/A	--	N/A	--	N/A	--	1.8E-09	10	N/A	--
SAFVC	2	N/A	--	N/A	--	1.7E-09	10	N/A	--	N/A	--	N/A	--	1.8E-09	10	N/A	--
SAOGC	2	N/A	--	N/A	--	1.7E-09	10	N/A	--	N/A	--	N/A	--	1.8E-09	10	N/A	--
SARGC	2	N/A	--	N/A	--	1.7E-09	10	N/A	--	N/A	--	N/A	--	1.8E-09	10	N/A	--
SARVC	2	N/A	--	N/A	--	1.7E-09	10	N/A	--	N/A	--	N/A	--	1.8E-09	10	N/A	--
Large aircraft crash onto containers; fire contained																	
SAFHF	3	N/A	--	1.7E-10	11	N/A	--	N/A	--	N/A	--	N/A	--	9.4E-10	11	N/A	--
SAFHC	3	N/A	--	N/A	--	9.1E-10	11	N/A	--	N/A	--	N/A	--	9.4E-10	11	N/A	--
SAFVC	3	N/A	--	N/A	--	9.1E-10	11	N/A	--	N/A	--	N/A	--	9.4E-10	11	N/A	--
SAOGC	3	N/A	--	N/A	--	9.1E-10	11	N/A	--	N/A	--	N/A	--	9.4E-10	11	N/A	--
SARGC	3	N/A	--	N/A	--	9.1E-10	11	N/A	--	N/A	--	N/A	--	9.4E-10	11	N/A	--
SARVC	3	N/A	--	N/A	--	9.1E-10	11	N/A	--	N/A	--	N/A	--	9.4E-10	11	N/A	--
Small aircraft crash onto containers; no fire																	
SAFHS	4	N/A	--	8.3E-07	10	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--
SAFHC	4	N/A	--	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--
SAFVC	4	N/A	--	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--
SAOGC	4	N/A	--	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--
SARGC	4	N/A	--	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--
SARVC	4	N/A	--	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	-
Small aircraft crash onto containers; fire not contained																	
SAFHF	5	N/A	--	8.3E-08	11	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	11	N/A	--

TABLE 5-20 (Continued)

SINTERIM STORAGE AIR OPTION (EVENTS/YR)

Scenario	No.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR
SAPHC	5	N/A	--	N/A	--	2.0E-12	11	N/A	--	N/A	--	N/A	--	1.6E-10	11	N/A	--
SAPVC	5	N/A	--	N/A	--	2.0E-12	11	N/A	--	N/A	--	N/A	--	1.6E-10	11	N/A	--
SAGGC	5	N/A	--	N/A	--	2.0E-12	11	N/A	--	N/A	--	N/A	--	1.6E-10	11	N/A	--
SARGC	5	N/A	--	N/A	--	2.0E-12	11	N/A	--	N/A	--	N/A	--	1.6E-10	11	N/A	--
SARVC	5	N/A	--	N/A	--	2.0E-12	11	N/A	--	N/A	--	N/A	--	1.6E-10	11	N/A	--
Small aircraft crash onto containers; fire contained																	
SAPHF	6	N/A	--	5.9E-07	10	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	10	N/A	--
SAPHC	6	N/A	--	N/A	--	1.4E-11	10	N/A	--	N/A	--	N/A	--	1.1E-09	10	N/A	--
SAPVC	6	N/A	--	N/A	--	1.4E-11	10	N/A	--	N/A	--	N/A	--	1.1E-09	10	N/A	--
SAGGC	6	N/A	--	N/A	--	1.4E-11	10	N/A	--	N/A	--	N/A	--	1.1E-09	10	N/A	--
SARGC	6	N/A	--	N/A	--	1.4E-11	10	N/A	--	N/A	--	N/A	--	1.1E-09	10	N/A	--
SARVC	6	N/A	--	N/A	--	1.4E-11	10	N/A	--	N/A	--	N/A	--	1.1E-09	10	N/A	--
Tornado-generated missiles penetrate containers; no detonation																	
SAPHS	7	N/A	--	8.4E-14	94	N/A	--	N/A	--	N/A	--	N/A	--	5.0E-16	94	N/A	--
SAPHS	7	N/A	--	N/A	--	8.4E-13	94	N/A	--	N/A	--	N/A	--	2.7E-15	94	N/A	--
SAPVS	7	N/A	--	N/A	--	8.4E-13	94	N/A	--	N/A	--	N/A	--	2.7E-15	94	N/A	--
SAGGS	7	N/A	--	N/A	--	8.4E-13	94	N/A	--	N/A	--	N/A	--	2.7E-15	94	N/A	--
SARGS	7	N/A	--	N/A	--	1.8E-12	94	N/A	--	N/A	--	N/A	--	6.2E-15	94	N/A	--
SARVS	7	N/A	--	N/A	--	1.8E-12	94	N/A	--	N/A	--	N/A	--	6.2E-15	94	N/A	--
Tornado-generated missile penetrate containers; detonation (or motor ignition for rockets)																	
SAPHC	8	N/A	--	N/A	--	3.1E-13	99	N/A	--	N/A	--	N/A	--	1.0E-15	99	N/A	--
SAPVC	8	N/A	--	N/A	--	3.1E-13	99	N/A	--	N/A	--	N/A	--	1.0E-15	99	N/A	--
SAGGC	8	N/A	--	N/A	--	3.1E-13	99	N/A	--	N/A	--	N/A	--	1.0E-15	99	N/A	--
SARGC	8	N/A	--	N/A	--	1.9E-12	94	N/A	--	N/A	--	N/A	--	6.6E-15	94	N/A	--
SARVC	8	N/A	--	N/A	--	1.9E-12	94	N/A	--	N/A	--	N/A	--	6.6E-15	94	N/A	--
Meteorite strikes the holding area																	
SAPHF	9	N/A	--	2.0E-11	26	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-11	26	N/A	--
SAPHC	9	N/A	--	N/A	--	2.2E-11	26	N/A	--	N/A	--	N/A	--	2.2E-11	26	N/A	--
SAPVC	9	N/A	--	N/A	--	2.2E-11	26	N/A	--	N/A	--	N/A	--	2.2E-11	26	N/A	--
SAGGC	9	N/A	--	N/A	--	2.2E-11	26	N/A	--	N/A	--	N/A	--	2.2E-11	26	N/A	--

TABLE 5-20 (Continued)

INTERIM STORAGE AIR OPTION (EVENTS/YR)

Scenario	No.	ANAD	RANGE FACTOR	AFG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR
SARGC	9	N/A	--	N/A	--	2.0E-11	26	N/A	--	N/A	--	N/A	--	2.0E-11	26	N/A	--
SARVC	9	N/A	--	N/A	--	2.0E-11	26	N/A	--	N/A	--	N/A	--	2.0E-11	26	N/A	--

File: STORHOLD.WK1 Page 1 Date 21-Aug-87

TABLE 5-20 (Continued)

INTERIM STORAGE SCENARIOS - NATIONAL/REGIONAL DISPOSAL OPTIONS
(PER YEAR)

SCENARIO ID	NO.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR
Large aircraft crash onto containers; no fire																	
SRBGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-10	10	1.5E-08	10
SRDHC	1	7.8E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	5.9E-08	10	3.6E-10	10	N/A	--
SRCGC	1	7.8E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRCHC	1	7.8E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	5.9E-08	10	3.6E-10	10	N/A	--
SRKGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRKHS	1	7.8E-09	10	5.3E-10	10	N/A	--	N/A	--	1.5E-09	10	N/A	--	3.6E-10	10	1.5E-08	10
SRKVS	1	N/A	--	N/A	--	N/A	--	4.6E-09	10	N/A	--	N/A	--	3.6E-10	10	N/A	--
SRMVC	1	7.8E-09	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--	3.6E-10	10	1.5E-08	10
SRPGC	1	7.8E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-10	10	1.5E-08	10
SRPHC	1	7.8E-09	10	N/A	--	4.5E-09	10	N/A	--	N/A	--	5.9E-08	10	3.6E-10	10	N/A	--
SRPVC	1	7.8E-09	10	N/A	--	4.5E-09	10	N/A	--	N/A	--	N/A	--	3.6E-10	10	1.5E-08	10
SRQGC	1	7.8E-09	10	N/A	--	4.5E-09	10	N/A	--	N/A	--	N/A	--	3.6E-10	10	1.5E-08	10
SRQVC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-10	10	1.5E-08	10
SRRGC	1	7.8E-09	10	N/A	--	4.5E-09	10	N/A	--	1.5E-09	10	N/A	--	3.6E-10	10	1.5E-08	10
SRRVC	1	7.8E-09	10	N/A	--	4.5E-09	10	N/A	--	1.5E-09	10	N/A	--	3.6E-10	10	1.5E-08	10
SRSVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-10	10	1.5E-08	10
Large aircraft crash onto containers; fire not contained																	
SRBGF	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	10	7.9E-07	10
SRDHC	2	4.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-08	10	1.9E-10	10	N/A	--
SRCGC	2	4.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRCHC	2	4.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-08	10	1.9E-10	10	N/A	--
SRKGF	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRKHF	2	4.2E-09	10	2.8E-10	10	N/A	--	N/A	--	7.9E-10	10	N/A	--	1.9E-10	10	7.9E-09	10
SRKVF	2	N/A	--	N/A	--	N/A	--	2.4E-09	10	N/A	--	N/A	--	1.9E-10	10	N/A	--
SRMVC	2	4.2E-09	10	N/A	--	N/A	--	N/A	--	7.9E-10	10	N/A	--	1.9E-10	10	7.9E-09	10
SRPGC	2	4.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	10	7.9E-09	10
SRPHC	2	4.2E-09	10	N/A	--	2.4E-09	10	N/A	--	N/A	--	3.1E-08	10	1.9E-10	10	N/A	--
SRPVC	2	4.2E-09	10	N/A	--	2.4E-09	10	N/A	--	N/A	--	N/A	--	1.9E-10	10	7.9E-09	10

File: STORHOLD.WK1 Page 2 Date 21-Aug-97

TABLE 5-20 (Continued)

INTERIM STORAGE SCENARIOS - NATIONAL/REGIONAL DISPOSAL OPTIONS
(PER YEAR)

SCENARIO ID	NO.	ANAD	RANGE FACTOR	AFG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR
SRQGC	2	4.2E-09	10	N/A	--	2.4E-09	10	N/A	--	N/A	--	N/A	--	1.9E-10	10	7.9E-09	10
SRQVC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	10	7.9E-09	10
SRRGC	2	4.2E-09	10	N/A	--	2.4E-09	10	N/A	--	7.9E-10	10	N/A	--	1.9E-10	10	7.9E-09	10
SRRVC	2	4.2E-09	10	N/A	--	2.4E-09	10	N/A	--	7.9E-10	10	N/A	--	1.9E-10	10	7.9E-09	10
SRSVF	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	10	7.9E-09	10
Large aircraft crash onto containers; fire contained																	
SRBGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11
SRDHC	3	2.2E-09	11	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-08	11	1.0E-10	11	N/A	--
SRCGC	3	2.2E-09	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRCHC	3	2.2E-09	11	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-08	11	1.0E-10	11	N/A	--
SRKGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRKHF	3	2.2E-09	11	1.5E-10	11	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11
SRKVF	3	N/A	--	N/A	--	N/A	--	1.3E-09	11	N/A	--	N/A	--	1.0E-10	11	N/A	--
SRMVC	3	2.2E-09	11	N/A	--	N/A	--	N/A	--	4.3E-10	11	N/A	--	1.0E-10	11	4.3E-09	11
SRPGC	3	2.2E-09	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11
SRPHC	3	2.2E-09	11	N/A	--	1.3E-09	11	N/A	--	N/A	--	1.7E-08	11	1.0E-10	11	N/A	--
SRPVC	3	2.2E-09	11	N/A	--	1.3E-09	11	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11
SRQGC	3	2.2E-09	11	N/A	--	1.3E-09	11	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11
SRQVC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11
SRRGC	3	2.2E-09	11	N/A	--	1.3E-09	11	N/A	--	4.3E-10	11	N/A	--	1.0E-10	11	4.3E-09	11
SRRVC	3	2.2E-09	11	N/A	--	1.3E-09	11	N/A	--	4.3E-10	11	N/A	--	1.0E-10	11	4.3E-09	11
SRSVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11
Small aircraft crash onto containers; no fire																	
SRBGS	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	10	1.2E-08	10
SRDHC	4	1.2E-08	10	N/A	--	N/A	--	N/A	--	N/A	--	9.9E-08	10	1.4E-08	10	N/A	--
SRCGC	4	1.2E-08	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRCHC	4	1.2E-08	10	N/A	--	N/A	--	N/A	--	N/A	--	9.9E-08	10	1.4E-08	10	N/A	--
SRKGS	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRKHS	4	1.2E-08	10	7.7E-06	10	N/A	--	N/A	--	1.1E-07	10	N/A	--	1.4E-08	10	1.2E-08	10

File: STORHOLD.WK1 Page 3 Date 21-Aug-87

TABLE 5-20 (Continued)

INTERIM STORAGE SCENARIOS - NATIONAL/REGIONAL DISPOSAL OPTIONS
(PER YEAR)

SCENARIO ID	NO.	ANAD	RANGE FACTOR	AFG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAF	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR
SRKVS	4	N/A	--	N/A	--	N/A	--	2.3E-08	10	N/A	--	N/A	--	1.4E-08	10	N/A	--
SRMVC	4	1.2E-08	10	N/A	--	N/A	--	N/A	--	1.1E-07	10	N/A	--	1.4E-08	10	1.2E-08	10
SRPGC	4	1.2E-08	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	10	1.2E-09	10
SRFHC	4	1.2E-08	10	N/A	--	1.8E-10	10	N/A	--	N/A	--	9.9E-08	10	1.4E-08	10	N/A	--
SRPVC	4	1.2E-08	10	N/A	--	1.8E-10	10	N/A	--	N/A	--	N/A	--	1.4E-08	10	1.2E-08	10
SRQGC	4	1.2E-08	10	N/A	--	1.8E-10	10	N/A	--	N/A	--	N/A	--	1.4E-08	10	1.2E-08	10
SRQVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	10	1.2E-08	10
SRRGC	4	1.2E-08	10	N/A	--	1.8E-10	10	N/A	--	1.1E-07	10	N/A	--	1.4E-08	10	1.2E-08	10
SRRVC	4	1.2E-08	10	N/A	--	1.8E-10	10	N/A	--	1.1E-07	10	N/A	--	1.4E-08	10	1.2E-08	10
SRSVS	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	10	1.2E-08	10
rSmall aircraft crash onto containers; fire not contained																	
SRBGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-09	10	1.3E-09	10
SRDHC	5	1.3E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-08	10	1.5E-09	10	N/A	--
SRCGC	5	1.3E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRCHC	5	1.3E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-08	10	1.5E-09	10	N/A	--
SRKGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRKHF	5	1.3E-09	10	8.2E-07	10	N/A	--	N/A	--	1.2E-08	10	N/A	--	1.5E-09	10	1.3E-09	10
SRKVF	5	N/A	--	N/A	--	N/A	--	2.4E-09	10	N/A	--	N/A	--	1.5E-09	10	N/A	--
SRMVC	5	1.3E-09	10	N/A	--	N/A	--	N/A	--	1.2E-08	10	N/A	--	1.5E-09	10	1.3E-09	10
SRPGC	5	1.3E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-09	10	1.3E-09	10
SRFHC	5	1.3E-09	10	N/A	--	1.9E-11	10	N/A	--	N/A	--	1.1E-08	10	1.5E-09	10	N/A	--
SRPVC	5	1.3E-09	10	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	1.3E-09	10
SRQGC	5	1.3E-09	10	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	1.3E-09	10
SRQVC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-09	10	1.3E-09	10
SRRGC	5	1.3E-09	10	N/A	--	1.9E-11	10	N/A	--	1.2E-08	10	N/A	--	1.5E-09	10	1.3E-09	10
SRRVC	5	1.3E-09	10	N/A	--	1.9E-11	10	N/A	--	1.2E-08	10	N/A	--	1.5E-09	10	1.3E-09	10
SRSVF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-09	10	1.3E-09	10
Small aircraft crash onto containers; fire contained																	
SRBGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	10	8.5E-09	10

File: STORHOLD.WK1 Page 4 Date 21-Aug-87

TABLE 5-20 (Continued)

INTERIM STORAGE SCENARIOS - NATIONAL/REGIONAL DISPOSAL OPTIONS
(PER YEAR)

SCENARIO ID	NO.	ANAD	RANGE FACTOR	AFG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAF	RANGE FACTOR	FBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR
SRDHC	6	5.6E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-08	10	1.0E-08	10	N/A	--
SRCGC	6	5.6E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRCHC	6	5.6E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-08	10	1.0E-08	10	N/A	--
SRKGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRKHF	6	5.6E-09	10	5.5E-06	10	N/A	--	N/A	--	7.8E-08	10	N/A	--	1.0E-08	10	8.5E-09	10
SRKVF	6	N/A	--	N/A	--	N/A	--	1.6E-08	10	N/A	--	N/A	--	1.0E-08	10	N/A	--
SRMVC	6	5.6E-09	10	N/A	--	N/A	--	N/A	--	7.8E-08	10	N/A	--	1.0E-08	10	8.5E-09	10
SRPGC	6	5.6E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	10	8.5E-09	10
SRPHC	6	5.6E-09	10	N/A	--	1.3E-10	10	N/A	--	N/A	--	7.1E-08	10	1.0E-08	10	N/A	--
SRPVC	6	5.6E-09	10	N/A	--	1.3E-10	10	N/A	--	N/A	--	N/A	--	1.0E-08	10	8.5E-09	10
SRBEC	6	5.6E-09	10	N/A	--	1.3E-10	10	N/A	--	N/A	--	N/A	--	1.0E-08	10	8.5E-09	10
SRQVC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	10	8.5E-09	10
SRRGC	6	5.6E-09	10	N/A	--	1.3E-10	10	N/A	--	7.8E-08	10	N/A	--	1.0E-08	10	8.5E-09	10
SRRVC	6	5.6E-09	10	N/A	--	1.3E-10	10	N/A	--	7.8E-08	10	N/A	--	1.0E-08	10	8.5E-09	10
SRSVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	10	8.5E-09	10
(Tornado-generated missiles penetrate containers; no detonation																	
SRBGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-16	94	9.6E-16	94
SRDHS	7	1.5E-11	94	N/A	--	N/A	--	N/A	--	N/A	--	6.2E-13	94	5.5E-15	94	N/A	--
SRCGS	7	9.1E-12	94	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-15	94	N/A	--
SRCHS	7	9.1E-12	94	N/A	--	N/A	--	N/A	--	N/A	--	3.8E-13	94	N/A	--	N/A	--
SRKGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
SRKHS	7	2.4E-12	94	7.8E-14	94	N/A	--	N/A	--	2.4E-12	94	N/A	--	5.0E-16	94	5.0E-16	94
SRKVS	7	N/A	--	N/A	--	N/A	--	2.4E-12	94	N/A	--	N/A	--	5.0E-16	94	N/A	--
SRMVS	7	1.3E-11	94	N/A	--	N/A	--	N/A	--	1.3E-11	94	N/A	--	4.9E-15	94	4.9E-15	94
SRPGS	7	7.8E-12	94	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-15	94	2.7E-15	94
SRPHS	7	7.8E-12	94	N/A	--	7.8E-12	94	N/A	--	N/A	--	3.2E-13	94	2.7E-15	94	N/A	--
SRPVS	7	7.8E-12	94	N/A	--	7.8E-12	94	N/A	--	N/A	--	N/A	--	2.7E-15	94	2.7E-15	94
SRQGS	7	7.8E-12	94	N/A	--	7.8E-12	94	N/A	--	N/A	--	N/A	--	2.7E-15	94	2.7E-15	94
SRQVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-15	94	2.7E-15	94

File: STORHOLD.WK1 Page 5 Date 21-Aug 87

TABLE 5-20 (Continued)

INTERIM STORAGE SCENARIOS - NATIONAL/REGIONAL DISPOSAL OPTIONS
(PER YEAR)

SCENARIO ID	NO.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR
SFRGS	7	1.7E-11	94	N/A	--	1.7E-11	94	N/A	--	1.7E-11	94	N/A	--	6.2E-15	94	6.2E-15	94
SFRVS	7	1.7E-11	94	N/A	--	1.7E-11	94	N/A	--	1.7E-11	94	N/A	--	6.2E-15	94	6.2E-15	94
SFSVG	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-15	94	1.7E-15	94
;Tornado-generated missile penetrate containers; detonation (or motor ignition for rockets)																	
SADHC	8	5.6E-12	99	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-13	99	5.9E-15	99	N/A	--
SFCGC	8	3.4E-12	99	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-15	99	N/A	-
SFCHC	8	3.4E-12	99	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-13	99	N/A		N/A	--
SFMVC	8	4.7E-12	99	N/A	--	N/A	--	N/A	--	4.9E-12	99	N/A	--	1.8E-15	99	1.8E-15	99
SFPGC	8	2.9E-12	99	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-15	99	1.0E-15	99
SFPHC	8	2.9E-12	99	N/A	--	2.9E-12	94	N/A	--	N/A	--	3.5E-13	99	1.0E-15	99	N/A	
SFPVC	8	2.9E-12	99	N/A	--	2.9E-12	94	N/A	--	N/A	--	N/A	--	1.0E-15	99	1.0E-15	99
SFQGC	8	2.9E-12	99	N/A	--	2.9E-12	94	N/A	--	N/A	--	N/A	--	1.0E-15	99	1.0E-15	99
SFQVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-15	99	1.0E-15	99
SFRGC	8	1.8E-11	94	N/A	--	1.8E-11	94	N/A	--	1.8E-11	94	N/A	--	6.6E-15	94	6.6E-15	94
SFRVC	8	1.8E-11	94	N/A	--	1.8E-11	94	N/A	--	1.8E-11	94	N/A	--	6.6E-15	94	6.6E-15	94
;Meteorite strikes the holding area																	
SFBGF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-10	26	2.1E-10	26
SFDHC	9	1.8E-10	26	N/A	--	N/A	--	N/A	-	N/A	--	1.9E-10	26	1.8E-10	26	N/A	--
SFUGC	9	2.2E-10	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	
SFCHC	9	2.2E-10	26	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-10	26	2.2E-10	26	N/A	-
SFLGF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	-
SFLHF	9	1.9E-10	26	1.9E-10	26	N/A	--	N/A	--	1.9E-10	26	N/A	--	1.9E-10	26	1.9E-10	26
SFLVF	9	N/A	--	N/A	--	N/A	--	1.9E-10	26	N/A	--	N/A	--	N/A	--	N/A	--
SFMVC	9	2.0E-10	26	N/A	--	N/A	--	N/A	--	2.0E-10	26	N/A	--	2.0E-10	26	2.0E-10	26
SFPGC	9	2.1E-10	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	26	2.1E-10	26
SFPHC	9	2.1E-10	26	N/A	--	2.1E-10	26	N/A	--	N/A	--	2.1E-10	26	2.1E-10	26	N/A	--
SFPVC	9	2.1E-10	26	N/A	--	2.1E-10	26	N/A	--	N/A	--	N/A	--	2.1E-10	26	2.1E-10	26
SFQGC	9	2.1E-10	26	N/A	--	2.1E-10	26	N/A	--	N/A	--	N/A	--	2.1E-10	26	2.1E-10	26
SFQVC	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	26	2.1E-10	26

File: STORHOLD.WK1 Page 6 Date 21-Aug-87

TABLE 5-20 (Continued)

INTERIM STORAGE SCENARIOS - NATIONAL/REGIONAL DISPOSAL OPTIONS
(PER YEAR)

SCENARIO ID	NO.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR
SRRGC	9	1.9E-10	26	N/A	--	1.9E-10	26	N/A	--	1.9E-10	26	N/A	--	1.9E-10	26	1.9E-10	26
SRRVC	9	1.9E-10	26	N/A	--	1.9E-10	26	N/A	--	1.9E-10	26	N/A	--	1.9E-10	26	1.9E-10	26
SRSVC	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-10	26	3.2E-10	26

TABLE 5-20 (Continued)

Interim Storage Barge Only (events/yr)

SCENARIO ID	NO.	APG	RANGE FACTOR
Large aircraft crash onto holding area; no fire			
SWKHS	1	2.0E-11	10
Large aircraft crash onto holding area; fire not contained			
SWKHF	2	1.1E-11	10
Large aircraft crash onto holding area; fire contained			
SWKHF	3	5.8E-12	11
Small aircraft crash onto holding area; no fire			
SWKHS	4	3.0E-07	10
Small aircraft crash onto holding area; fire not contained			
SWKHF	5	3.2E-08	11
Small aircraft crash onto holding area; fire contained			
SWKHF	6	2.1E-07	10
Tornado-generated missile penetrates vault			
SWKHC	7	2.5E-14	94
Meteorite strikes vault			
SWKHF	9	1.0E-10	26
Large aircraft crash onto lighter; no fire			
SWKHS	10	7.7E-12	10
Large aircraft crash onto lighter; fire not contained			
SWKHF	11	4.1E-12	10
Large aircraft crash onto lighter; fire contained			
SWKHF	12	2.2E-12	11
Small aircraft crash onto lighter; no fire			
SWKHS	13	1.2E-07	10
Small aircraft crash onto lighter; fire not contained			
SWKHF	14	1.2E-08	11
Small aircraft crash onto lighter; fire contained			
SWKHF	15	6.2E-08	10
Large aircraft crash onto ship; no fire			
SWKHS	16	3.3E-11	10
Large aircraft crash onto ship; fire not contained			

TABLE 5-20 (Continued)

Interim Storage Barge Only (events/yr)

SCENARIO ID	NO.			APG	RANGE FACTOR
SWKHF	17			1.8E-11	10
Large aircraft crash onto ship; fire contained					
SWKHF	18			9.5E-12	11
Small aircraft crash onto ship; no fire					
SWKHS	19			4.8E-07	10
Small aircraft crash onto ship; fire not contained					
SWKHF	20			5.1E-08	11
Small aircraft crash onto ship; fire contained					
SWKHF	21			3.4E-07	10

The trends indicated by the frequency results are as follows:

Externally-Induced Events

1. Tornado and high wind

   a. Munitions stored outdoors or in warehouses are generally more susceptible to tornado strikes. APG, PBA, NAAP, TEAD, and UMDA have warehouses. PBA and NAAP are in Tornado Zone I while APG is in Tornado Zone II (Zone I has the highest tornado frequency). TEAD and UMDA are in Tornado Zone III.

   b. The transportation containers provide some protection to the munitions which are temporarily stored in open holding areas.

2. Meteorite strike

   a. Munitions stored in warehouses are more susceptible to meteorite strikes. Since fire is generally present, a meteorite strike may involve the entire warehouse inventory.

   b. The frequency of breaching ton containers in OFCs or barge packages in the holding area is of the same order of magnitude as the unpackaged ton containers stored in warehouses (at NAAP and UMDA). However, the OFC provide the spray tanks an additional layer of protection than spray tanks in warehouses (at TEAD) which are normally stored in their overpacks.

3. Aircraft crashes

a. Munitions stored outdoors are generally more susceptible to these events. APG, PBA, and TEAD have ton containers stored outdoors. However, the aircraft crash probabilities at APG and PBA are relatively higher than the other sites.

b. Igloos provide minimal protection from direct crashes of large aircraft. The accident becomes more serious when burstered munitions are involved.

c. Large aircraft crash frequencies at APG, LBAD, and TEAD greatly increase for the air option because of the additional landings and takeoffs at these sites.

d. The OFCs and barge packages do not provide additional protection to the munitions from direct aircraft crashes.

4. Earthquakes

a. Earthquakes, particularly in high seismic locations such as TEAD, could cause stacked munitions to be punctured. However, the probabiity of having a probe present inside an igloo is quite low.

b. Detonations due to earthquake-induced drops are at least two orders of magnitude less likely than punctures.

c. There is a significantly high frequency earthquake-induced agent releases to munitions stored in warehouses at NAAP, TEAD, and UMDA.

Leaker-Related Events

1. Forklift drop accidents can occur more frequently than forklift tine puncture accidents.

2. Use of a lifting beam instead of a tine leads to an order of magnitude decrease in drop frequency.

5.5. UNCERTAINTY ANALYSIS

5.5.1. Overview

The frequency results presented in Tables 5-16, 5-17, and 5-18 are median values. The values shown in the range factor column represent the ratios of the 95^{th} percentile values to the median values. The range factors vary from 10 to almost 100. The tornado frequency results have the highest uncertainties, largely because of the difficulty to accurately model the probability that the missile will be in the proper orientation to penetrate the munition and how many missiles per square foot of wind will actually be present. The ability to model low-impact detonations also leads to large uncertainties in the final results. The data available are scarce and sometimes not directly applicable to the scenario being analyzed.

5.5.2. Error Factors

In those cases where sufficient information exists to determine the upper and lower bound values, the error factor was derived by assuming that the upper bound value is equivalent to the 95^{th} percentile. The engineers' best estimate is taken as the median value based on the properties of the lognormal distribution. This choice is rather conservative, since the mean value of the resulting distribution becomes larger than the best estimate or recommended value.

In many cases, however, the data sources were limited. Therefore, the assignment of error factors was entirely based on engineering judgment, taking into consideration the important parameters which may influence a particular variable. The generic guidelines for the uncertainty assessment is shown in Table 5-21.

5.5.2.1. Tornado Sequence Uncertainties. The frequency of the initiating event itself (i.e., tornado wind of sufficient intensity to

TABLE 5-21
GENERIC UNCERTAINTY MODELS

- External events (both from natural causes and human-caused events external to the operation, e.g., aircraft crash): EF = 10.

- Component or equipment failure rates were generally assigned an error factor of 3. An exception to this rule is when the analyst does not feel confident with the applicability of the data to a particular demil equipment, component, or operation. In such case, a larger error factor was used, ranging from 5 to 10.

- In cases where the event probability range from 0.1 to 0.9, and was derived largely from engineering judgment, the error factor used is:

Probability:	0.1 to 0.3	EF = 2.0
Probability:	0.4 to 0.6	EF = 1.5
Probability:	0.7 to 0.8	EF = 1.4
Probability:	0.9	EF = 1.0

- Munition failure probability due to puncture that was calculated using standard mathematical models was assigned an error factor of 5.

generate missiles occurs) is assigned an error factor of 10, per Table 5-19. The conditional probability of a missile's hitting the structure and penetrating the munition is assigned an error factor of 50. As explained in Section 5.2.1.1 (Eq. 5-2), this event is the product of four variables. The uncertainty is largely due to the variable D_e which is the number of missiles per square foot of wind. The conditional probability of a burstered munition's detonating when hit by a missile is assigned an error factor of 2.

5.5.2.2. Meteorite Strike Sequence Uncertainty. The frequency of a meteorite strike is assigned an error factor of 10. The conditional probability of a meteorite's penetrating and rupturing the munition is the product of (1) fraction of stone and iron meteorites capable of penetrating the target; (2) target area; and (3) spacing factor. This event is assigned an error factor of 10. The uncertainty is largely due to the fraction of stone and iron meteorites capable of penetrating the structure.

5.5.2.3. Aircraft Crash Sequence Uncertainties. The aircraft crash frequency is assigned an error factor of 10. Aircraft crash accident sequences with or without fires (from impact) have been considered. For this reason no uncertainties were assigned to either the probability of having a fire (0.45) or no fire (0.55). The uncertainties associated with the structural damage (i.e., igloo or warehouse) given an aircraft crash are given in Table 5-8. For events with probabilities greater than 0.1, the uncertainties assigned followed the guidelines given in Table 5-19.

5.5.2.4. Earthquake Sequence Uncertainties

Storage Igloos

The initiating event, earthquake occurs, is assigned an error factor of 10. The conditional event, munition punctured given a

drop, is assigned an error factor of 5. The puncture probability is a function of drop height, weight and pressure of a probe of sufficient length and density. The uncertainty is largely due to the last variable. Note also that no uncertainty from errors with the models has been considered, since this is beyond the state-of-the-art of present-day uncertainty analysis.

Warehouse Storage

Event 1: Earthquake Occurs

The initiating event frequency is assigned an error factor of 10.

Event 2: "K" Warehouses Damaged by Earthquake

Uncertainty factors for values above 0.1 are taken from Table 5-21. For probabilities between 0.01 and 0.1, an uncertainty factor of 3 is recommended. Probabilities below 10^{-2} are assigned an uncertainty factor of 3. The uncertainty distribution in each case is lognormal with a median equal to P_2. Recall that P_2 is the independent warehouse damage probability, given an earthquake.

Event 3: Munitions Damaged in "L" Warehouses

If munition damage results from building collapse, the uncertainty in Event 3 is negligible because the analysts are very confident (i.e., essentially certain) that munition damage occurs. If the warehouse remains intact, the uncertainty in Event 3 is dominated by the uncertainty in P_p - the conditional probability that a fallen container is punctured. From Table 5-21 the uncertainty distribution is lognormal with an uncertainty factor of 5 and a median equal to the point estimate for P_p.

Event 4: Ignition at "M" Warehouses

The ignition probability is a function of P_{osp} and P_{EL}, that is, the probability that offsite power is available following the quake, and that an electrical fault occurs. The uncertainty in these probabilities was quantified using the methodology reported in the Zion PRA. Moreover, the data used to quantify the uncertainty in P_{osp} also comes from the Zion study.

The major uncertainty in P_{EL} is due to the application of a generic Modified Mercalli fragility model to the warehouses. Depending upon the actual, as-built design features, the median failure threshold can vary by a factor of 2 about the nominal value. Thus, an uncertainty factor of 2 was applied to the uncertainty in the failure threshold.

Event 5: Ignition at Warehouse with Damaged Munitions

All parameters and distributions required to quantify the uncertainty in Event 5 are presented in the Event 4 analysis.

5.5.2.5. Handling Accident Sequence Uncertainties. All initiating events associated with munitions handling (i.e., drops, collisions, forklift tine punctures) were assigned an error factor of 10. The conditional probability of puncturing the munitions given any one of the initiating events is assigned an error factor of 3. The probability of causing a low-impact detonation (i.e., drop from 6 ft or lower) is assigned an error factor of 10.

5.6. REFERENCES

5-1. Science Applications International Corporation, "Probabilities of Selected Hazards in Disposition of M55 Rockets," U.S. Army Toxic and Hazardous Materials Agency, M55-CS-2, November 1985.

5-2. "Supporting Calculations for the Risk Analysis of the Continued Storage of Chemical Munitions," GA Technologies Inc., (Issue 2), Volumes 1, 2, and 3, August 1987.

5-3. Department of the Army, U.S. Army Materiel Development and Readiness Command, "Safety Manual," DARCOM-R-385-100, August 1981.

5-4. Coats, D. W., "Natural Phenomena Hazards Modeling Project: Extreme Wind/Tornado Hazards Models For Department of Energy Sites," UCRL-53526, Lawrence Livermore National Laboratory, February 1984.

5-5. Lawrence Livermore National Laboratory, "Explosives Handbook, Properties of Chemical Explosives and Explosive Simulants," March 16, 1981.

5-6. Telephone conversation: R. Perry (OPMCM) and C. Everline (GA), June 15, 1987.

5-7. "Status Report on Packaging Concepts for the Transportation of Chemical Munitions," presented by MITRE Corporation to OPMCM, June 17, 1987 (modified on June 26, 1987).

5-8. Blake, V. E., "A Prediction of the Hazards from Random Impact of Meteorites on the Earth's Surface," Sandia Laboratories SC-RR-68-838, December 1968.

5-9. Solomon, K. A., K. C. Erdmann, and D. Okrent, "Estimate of the Hazards to a Nuclear Reactor from the Random Impact of Meteorites," Nuclear Technology, Vol. 25, January 1975.

5-10. Clarke, R. K., et al., "Severities of Transportation Accidents," SCA-74-0001, Sandia National Laboratories, July 1976.

5-11. Weals, F. H., and B. Finder, "ESKIMO V Magazine Separation Test," NUC-TP-6076, Naval Weapons Center, China Lake, February 1979.

5-12. MacGorman, D. R., et al., "Lightning Strike Density fot the Contiguous United States From Thunderstorm Duration Records," U.S. NRC Report NUREG/CR-3759, April 1984.

5-13. Flood Plain Information Part 11 Arkansas River, Caney Bayou, and Tributaries; Department of the Army, Corps of Engineers, Vicksburg, Miss., November 1973.

5-14. Bell, B. J., et al.,"Human Reliability and Sensitivity Analyses Supporting the Chemical Munitions Demilitarization Risk Assessment," Battelle Columbus Division, July 10,1987.

5-15. GA Technologies Inc., "Risk Analysis of the Continued Storage Option," GA Draft Report GA-C18564, Rev. 1, November 1986.

5-16. U.S. Army Armament, Munition, and Chemical Command, "Quarterly Chemical Munitions Leaker Report (RCS-RCQA-123, Classified)," October 15, 1985, January 1986.

5-17. "Cost Estimates Prepared in Support of the Transportation Concept Plan," Draft Report prepared by MITRE Corporation, June 1987.

5-18. "Independent Evaluation/Assessment of Rocket, 115-mm: Chemical Agent (GB or VX), M55," U.S. Army Materiel Systems Analysis Activity (AMSAA), October 1985.

5-19. Meeting at OPMCM, Aberdeen, Maryland on August 13-14, 1987 (Attendees: OPMCM, ORNL, JBF Associates, H&R Technical Associates, Battelle, and GA staff).

6. SCENARIO LOGIC MODELS FOR HANDLING

The objectives of this section are to: (1) define those activities considered as "handling" in the analysis; (2) address the assumptions and data that have been used to evaluate the handling accident scenarios; (3) present the analytical structure of the evaluation; and (4) discuss the quantification of the accident scenarios.

Section 3 provides an overview of how munitions are handled at the sending site for transfer to the collocation sites (NDC or RDC) and at the NDC or RDC itself prior to the demilitarization operations. The activities associated with the handling of munitions at the original storage site and at the receiving site (NDC or RDC) are diagramed in overview form in Fig. 3-1. In brief the Army's plan is to package the munitions that are to be transported outside an installation's boundaries in offsite transportation containers to protect them against impact, crush, puncture, fire, and immersion while being transported. The munitions will be subjected to many handling operations during their movement to the railhead, airstrip or loading dock for offsite transport by rail, air or sea. Upon arrival at the receiving site, handling operations include unloading, movement to an interim storage facility, and unpackaging from offsite containers. The collocated munitions and the items originally stored at the receiving site would ultimately be subject to packaging in onsite containers, and finally movement by truck to the demilitarization facility. At the disposal facility, handling operations include unpacking the transport containers and transfer of the munitions to the materials handling equipment within the plant. For this study, movement by forklifts is considered to be a handling operation rather than transportation. However, onsite truck transportation is considered a transportation operation.

6.1. GENERAL HANDLING PROCEDURES AND ASSUMPTIONS

6.1.1. Rail Option

Although there may be some slight differences in the munition handling procedures at each site, for this analysis the following general assumptions were made and are intended to apply to all the sites, as appropriate:

1. Forklifts are used to move munition pallets for short distances. Electric forklifts are used inside storage igloos, warehouses, maintenance facilities, storage facilities, MHIs or MDBs. Fossil fueled forklifts are used outside these facilities.

2. A forklift will handle one pallet or container at a time.

3. A forklift equipped with a lifting beam is used to move and carry the ton containers.

4. Ton containers will have been tested ultrasonically to determine susceptibility to leak development in the plug and valve area during transportation. The ton containers indicating potential leak development will have both their valves and plugs replaced with plugs. The handling activities associated with these operations are considered "preparatory" procedures and are not part of this risk analysis. Further, it is assumed that the ton containers will not leak thereafter and this analysis does not address handling of leaking ton containers.

5. The mines will be transported with their fuzes still in the drums.

6. The spray tanks and weteye bombs will not be removed from their overpack for placement inside the offsite transportation container. These items are handled with forklift with tines.

7. Munition pallets or single items will be placed directly inside the offsite transportation container using the storage area electric forklift, except for the ton containers stored in outdoor storage yards (at APG and PBA) where a diesel forklift is used. The transportation container will be already loaded and secured on a 40-ft flatbed truck parked just outside the storage facility (igloo apron, warehouse or storage yard's entrance).

8. The offsite transportation package inner container is 72-in. inner diameter, 90-in. outer diameter and 18-ft long. The outer container is an 8 x 8 x 20 ft steel iso-container. The package is designed to provide the munitions with maximum protection from impact, crush, puncture, and fire. It is capable of providing a seal.

9. The 4.2-in. mortars and 105-mm cartridges will have their propellant removed prior to the start of the demil campaign and these munitions will be handled as palletized projectiles. The handling activities associated with the propellant removal operations are considered "preparatory" procedures and are not part of this risk analysis.

10. Munitions found to be leaking prior to transport during igloo monitoring and inspection will be treated before further movement. The activities associated with the treatment of leakers which have developed during storage were considered as part of the interim storage activities and are not part of the handling accidents presented in this section.

11. At the holding area, the containers are unloaded one at a time from the truck using standard Cargo Handling Equipment (CHE) similar to a piggypacker. This is a four-wheeled munition handling equipment that lifts the containers from the top. Loading procedures are similar.

12. The containers will not be stacked while in the holding area.

13. This analysis addresses leaking munitions which may have developed during onsite transportation, at the storage igloo, or at the holding area. At the holding area, daily low-level monitoring will be performed on the transportation containers for munitions leakage. The containers found to have leaking munitions will be brought by truck to a leakers processing facility.

14. At the leakers processing facility, the transportation container will be brought to an inner area where the leaker is identified, removed from the pallet, decontaminated and repacked in an overpack. For the purpose of this analysis, once overpacked the leakers are like all other munitions and no further specific handling activities need be considered.

15. A maximum of 16 ONC containers will be stored inside the MHI. The containers will not be stacked.

16. In the UPA there could be as many as six onsite transportation containers at any given time. The onsite containers will not be stacked.

There is a possibility of transporting arriving munitions directly from the rail car to the MDB. If this was the case, there will be less handling operations involved than what is assumed in this analysis.

However, the analysis conservatively assumes movement from the rail to the interim storage areas.

6.1.2. <u>Air Transport Option</u>

The procedures and assumptions listed in Section 6.1.1, except for those dealing with munition types other than ton containers, projectiles, and rockets, apply to the air transport option handling. Items 5, 6, and 9 do not apply because only these three munition types will be airlifted.

6.1.3. <u>Marine Option</u>

For offsite marine shipment, the only munition type is the ton container. Thus, the procedure items number 5, 6, and 9 in Section 6.1.1 do not apply here. Another difference is that the ton container will be shipped in a vault instead of an offsite transport container (OFC). This affects items 7 and 8 which are amended to read as follows:

7a. Ton containers for marine shipment will be placed in a vault positioned just outside the storage facility (storage yard entrance) using forklifts.

8a. The vault is designed to provide the munitions with maximum protection from impact, crush, puncture, and fire. Vaults are handled with equipment which lifts the vaults from the top, such as a forklift with lifting beams (not with tines).

Another difference is that the receiving site risk in terms of agent release only (not in public effects) can be assumed to be the same as disposal of the APG stocks at TEAD.

6.2. CHRONOLOGY OF HANDLING OPERATIONS

The handling operations were categorized primarily into two groups: (1) handling operations (HC, HA, and HW for rail, air, and water transport, respectively) between the storage facilities and the offsite transporter at the sending site, and between the offsite transporter and the MHI at the receiving site and (2) handling operations at the facility (HF), including movement from the MHI to the MDB entrance and then to the UPA. A third category of handling operations was also considered: handling at the igloo prior to onsite transport at the MHI and unloading at the MHI. These operations served as the basis for the identification of relevant handling accident initiating events presented in Section 4.

Handling operations specific to the sending sites are the placement of munitions inside offsite transportation containers and the handling of leakers found to have developed during onsite transportation from their storage area to the holding area. Handling operations specific to the receiving site for collocated munitions are the leakers processing facility-related handling operations for leakers which have developed during offsite transportation, the unloading of munitions from the offsite containers and the loading of munitions (both those that were collocated and those that were originally stored at the site) in the onsite containers at the storage area.

The accident scenario analysis also addressed both leaking and nonleaking munitions. Army experience on the movement of various munitions suggests that rockets, MC-1 bombs, and ton containers will more likely leak during transport. However, the valves and plugs of ton containers will be tested and replaced, if necessary, prior to offsite movement. Thus, only additional handling operations necessary to isolate and overpack leaking rockets and bombs are evaluated both at the sending and receiving sites.

A flow diagram of the handling operations at both the sending and receiving sites is shown in Figs. 6-1 and 6-2. The handling steps at the sending sites are as follows:

1. For rail and air transport options, an electric forklift picks up a pallet of munitions inside the storage area, carries it to a truck with an OFC already secured on it, and places the pallet inside the container. Ton containers stored in open yards are normally moved to the truck by a diesel forklift.

2. For the marine transport option, the ton containers will be placed in the transportation package positioned at the storage yard's entrance, using a diesel forklift with lifting beams.

3. The 40-ft flatbed truck transports the container to the holding area about one mile away.

4. A cargo handling equipment (CHE) picks up the OFC from the truck and places it in the holding area.

5. When ready for shipment, a CHE picks up the OFC at the holding area and places it on a train car for rail transport, or on a truck for air or marine transport.

6. At the air strip, the OFC is loaded into the aircraft by conveyor. At the marine loading dock, the OFC is loaded by crane into the barge, and the barge is loaded by crane later into the LASH.

7. At the sending site, the leaker isolation operations are as follows: after evidence of a leak in the offsite transportation container at the holding area, the container is loaded on a truck for transport to the leaker processing facility (LPF). At the LPF, the container is unloaded from the truck

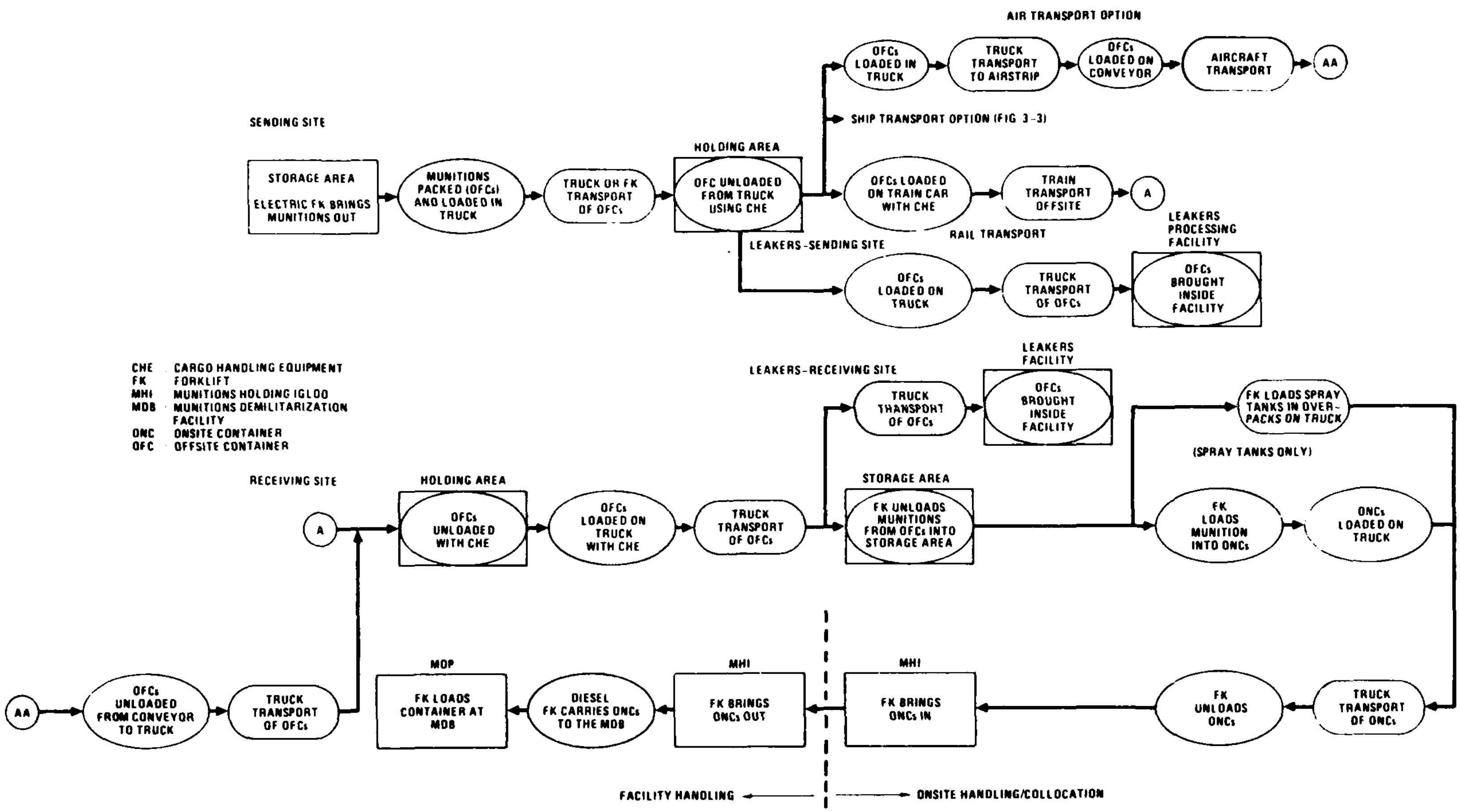


Fig. 6-1. Flow diagram for handling operations, collocation option

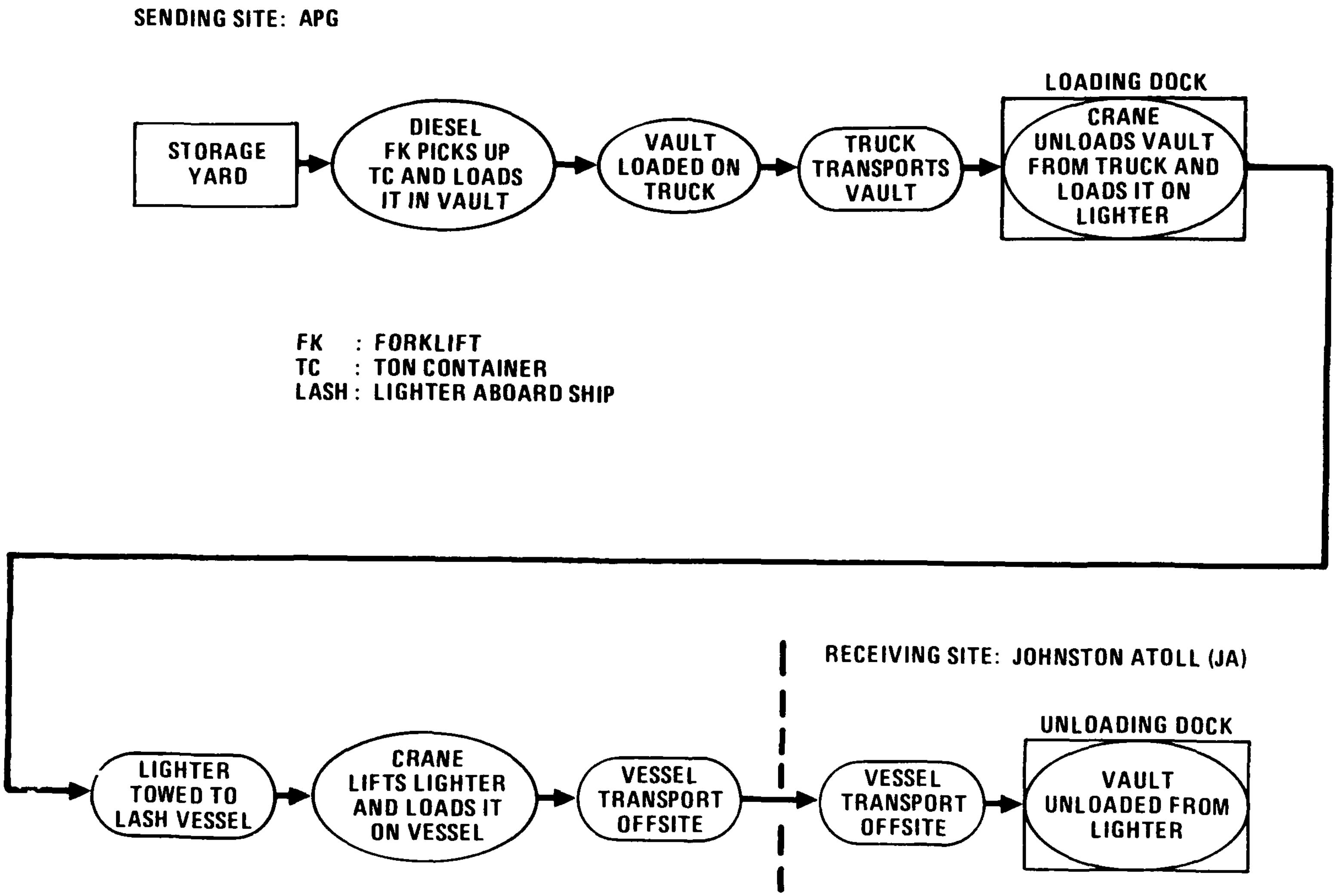


Fig. 6-2. Handling activities for ship transport option

using a CHE and is brought to an inner area of the facility. After identification of the pallet containing the leaker, an electric forklift picks up the pallet from the container and unloads it on the floor of the facility. The leaker is removed from the pallet, carried to a PIG or overpack ready for reception of the leaker, and placed inside it. These operations are done manually for rockets and using an electric forklift for bombs.

The handling steps at the receiving sites are as follows:

1. For rail transport, after arrival of the train at the destruction site (NDC or RDC), a CHE immediately unloads the containers from the train car and places it in a holding area, where the container is kept and periodically monitored for agent for up to 14 days.

2. For air transport, the OFC is offloaded from the plane by conveyor onto a truck and transported to the holding area.

3. For sea transport, this analysis assumes risk is the same as at TEAD for unloading rail transport vehicles.

4. A CHE picks up the offsite transportation container at the holding area and loads it on a flatbed truck.

5. The truck transports the container to the storage igloo about one mile away.

6. Upon arrival at the storage igloo, the transportation container stays on the truck and is monitored prior to being opened. An electric forklift rolls up to the truck, picks up the pallet of munitions from the container and moves it directly into the storage igloo. The spray tanks arriving at

the storage igloo of the receiving site are in their overpack inside the offsite transportation container. They are removed from the offsite container like all the other munitions at the storage facility and remain in their overpack.

7. When ready for demilitarization, an electric forklift picks up the pallet inside the storage igloo and loads it into an onsite transportation container (single cylindrical container) located immediately outside the facility (igloo apron). Two exceptions are the spray tank and weteye bombs, which are not placed in an ONC but which are handled in their overpacks using forklifts.

8. A diesel forklift with a lifting beam picks up the onsite transportation container at the storage facility apron and loads it on a flatbed truck.

9. The truck transports the onsite container to the munitions holding igloo (MHI) located one mile away.

10. At the MHI, a diesel forklift with lifting beams picks up the container from the truck and places it at the igloo apron.

11. An electric forklift picks up the container at the MHI apron and places it inside the MHI to await demilitarization.

12. When ready for further processing, an electric forklift picks up the container inside the MHI and brings it to the MHI apron.

13. A diesel forklift picks up the container at the MHI apron and carries it to the MDB elevator where it is taken to the second level.

14. An electric forklift takes the container out of the elevator and moves it to the UPA.

15. Whenever a leaker is suspected (during periodic monitoring activities at the holding area or at the storage facility), the truck transports the offsite transportation container to a leakers processing facility for leaker isolation. The leakers processing facility at the receiving site is capable of handling contaminated offsite transportation containers.

Based on these handling procedures, the number of operations for each scenario is calculated.

6.3. ACCIDENT SCENARIOS FOR HANDLING ASSOCIATED WITH RAIL TRANSPORT

According to the Master Logic Diagram (Section 4), there were four types of initiating events which could lead to agent release: munition drop, forktine puncture, forklift collision, and leakage. The list was further expanded to specific accident sequences to address conditions such as (1) where the accident occurs (i.e., storage area, leakers processing facility, etc.); (2) munition configuration (i.e., handled as pallets or singularly); (3) the presence of any packaging (i.e., bare or in transportation container); and (4) whether it applies only to leaking or nonleaking munitions. This resulted in the identification of six families of initiating events for handling, as given in Table 4-3.

Event tree logic models were developed for the first five of these six families of initiating events, as shown in Figs. 6-3 through 6-7. Leakage scenarios were analyzed without using logic models. For each tree, the scenario begins with the disruptive occurrence at a specified location and munition configuration; the subsequent events, which affect whether or not agent is released or how much is released, were then developed.

The initiating events for the accident scenarios evaluated are largely due to operator error. Except for forklift collision accidents in which the frequency data used was derived from industry data which already incorporated human error contribution to the overall event frequency, a human reliability task analysis was performed as described below to determine the occurrence of such events as dropping of munitions, forklift tine accidents, etc. The forklift collision frequency is 4.3×10^{-6} per operation.

The event tree sequences for the onsite handling operations (HC), related to the movement of munitions to various locations, are coded

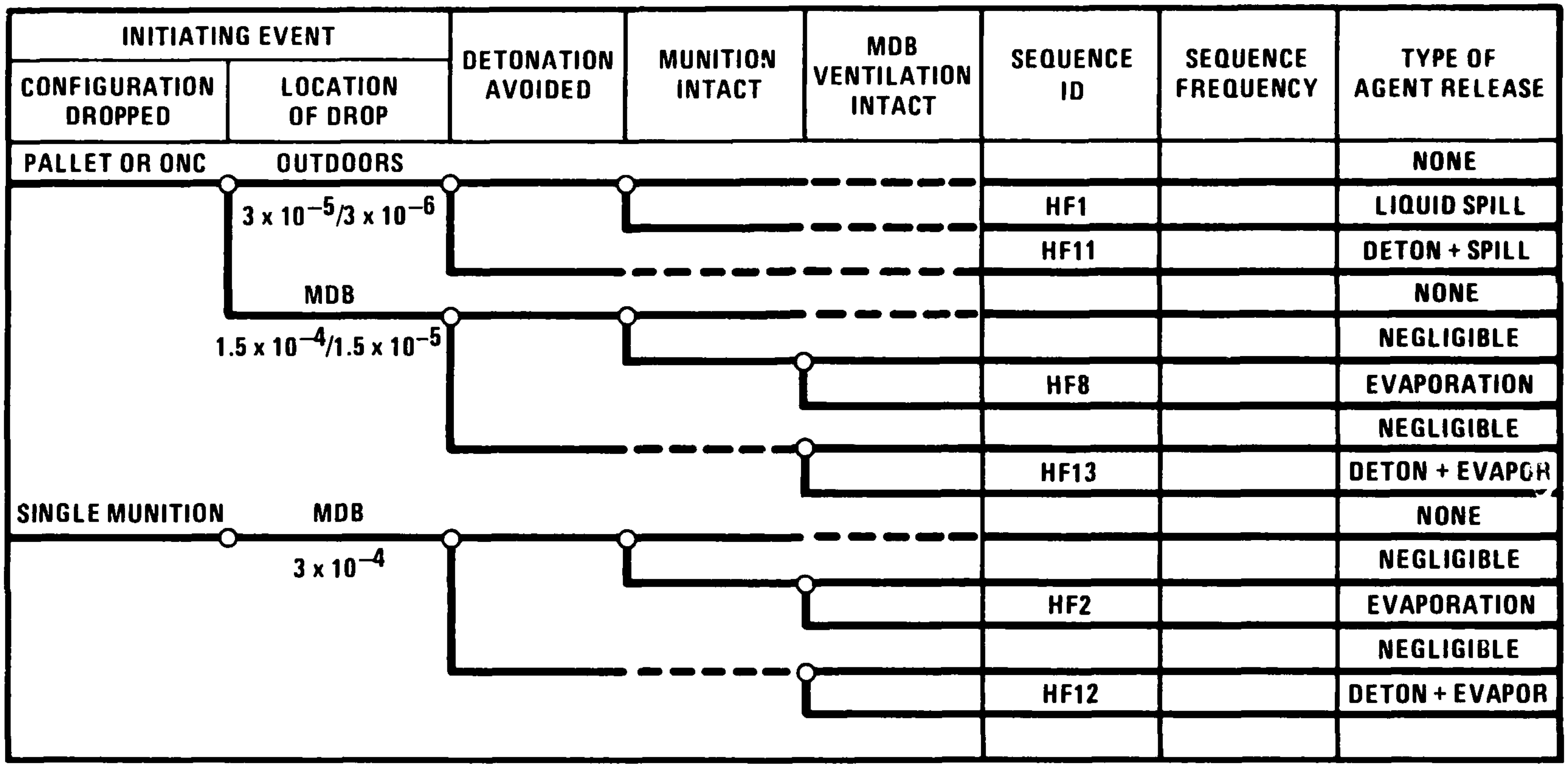


Fig. 6-3. Event tree for drop of munitions(s) during handling at facility

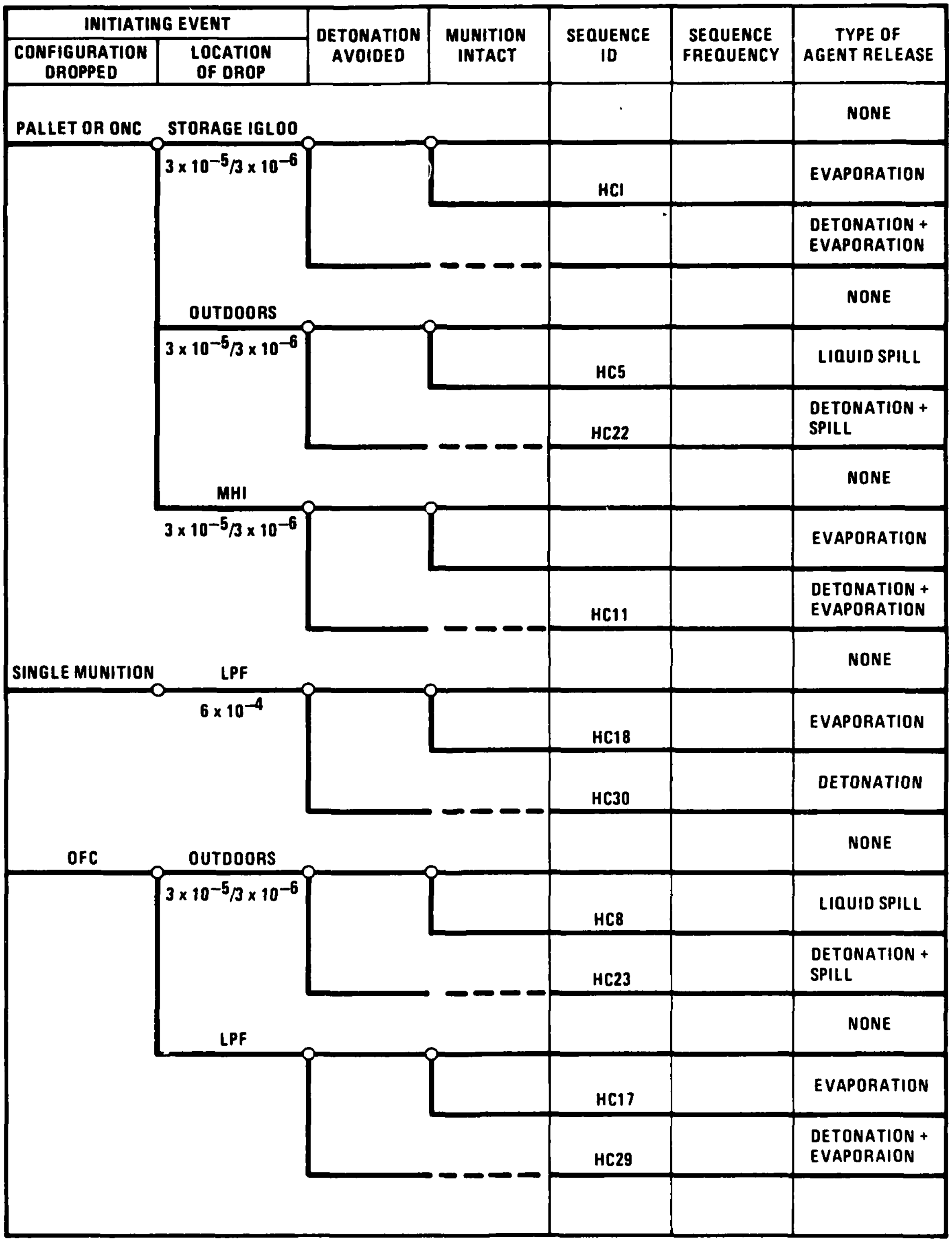


Fig. 6-4. Event tree for drop of munition(s) during handling operations other than at facility

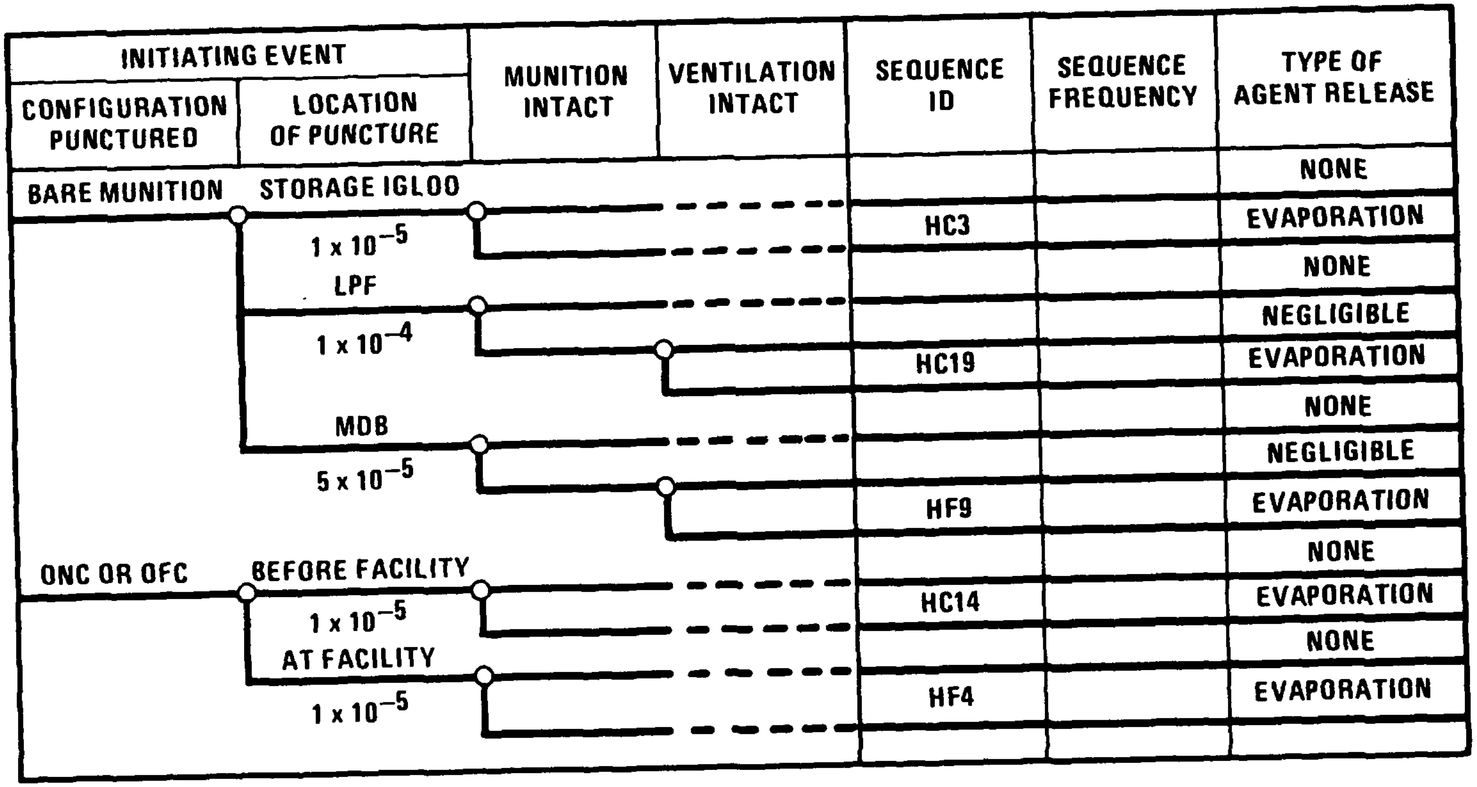


Fig. 6-5. Event tree for forklift tine punctures during handling

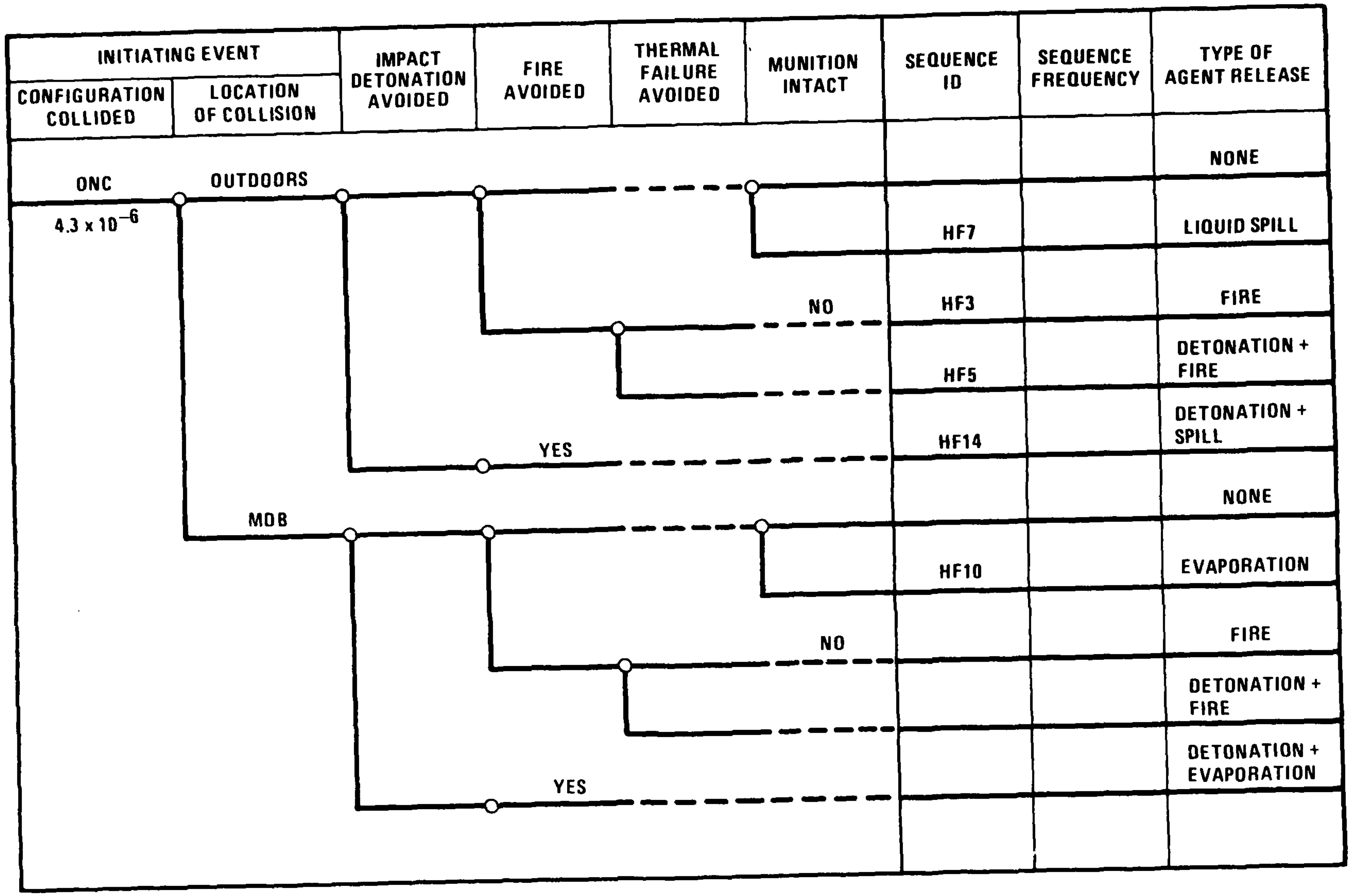
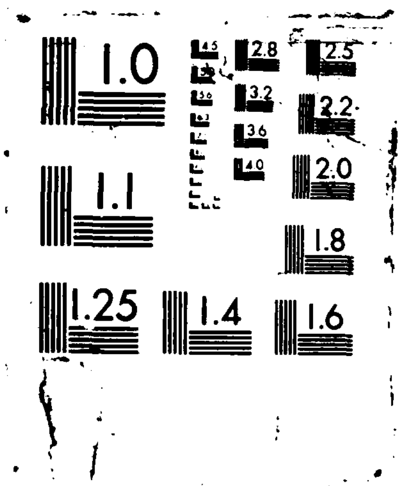


Fig. 6-6. Event tree for vehicle collisions during handling at facility

AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO CA A W BARSELL ET AL. AUG 87 GA-C-18563 4/13

UNCLASSIFIED SAPEO-CDE-IS-87006 DAAA15-85-D-0022 F/G 15/6.3 NL


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

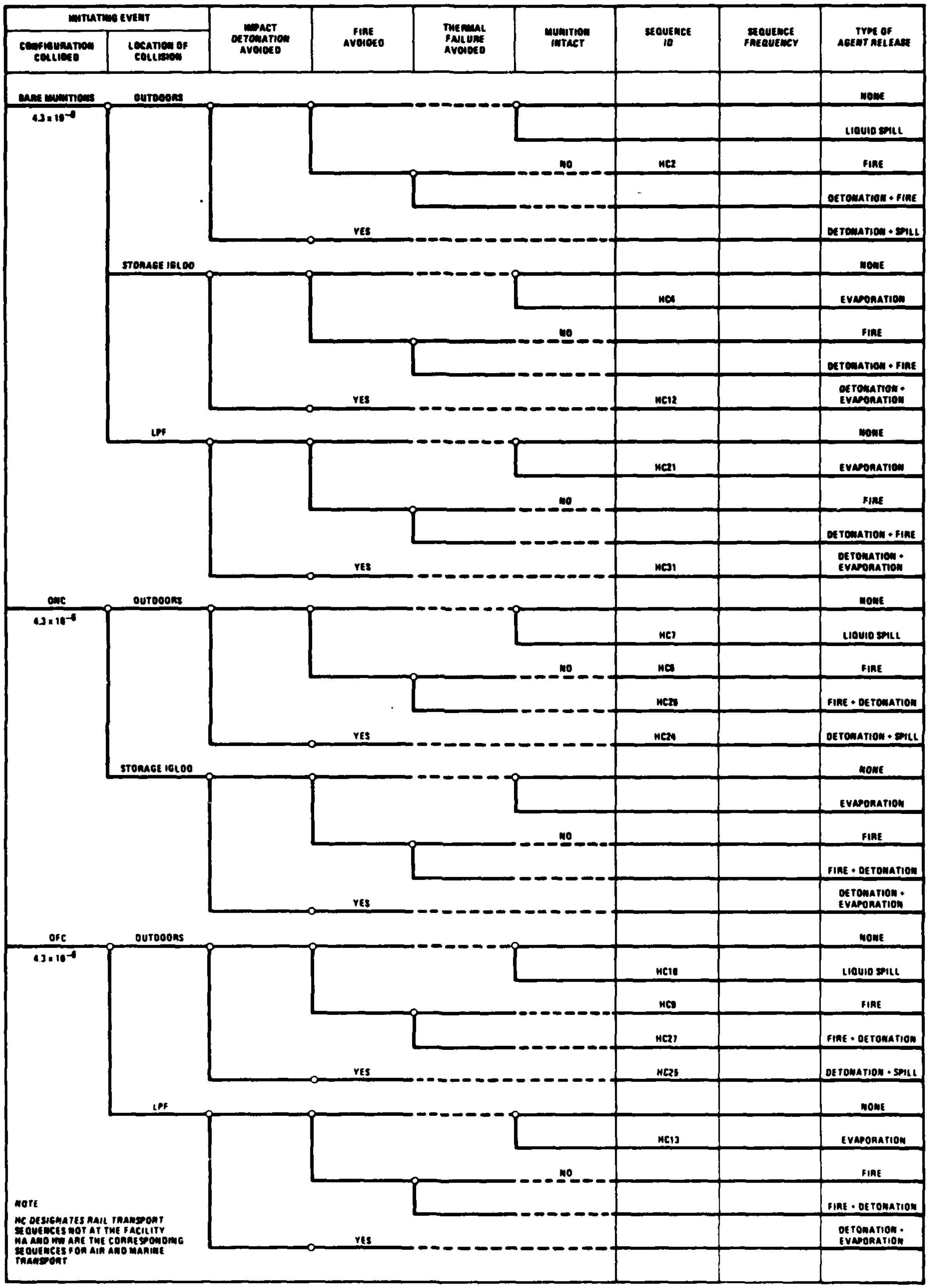


Fig. 6-7. Event tree for vehicle collisions during handling other than at facility

differently from those at the demilitarization facility (HF). The complete list of sequences is shown in Table 6-1. Due to recent programmatic changes, a few sequences have now become obsolete and are no longer applicable. For example, onsite container is not handled with a forklift with tines as had been previously assumed (delete HC14). An electric forklift is always used at the leaker processing facility, which deletes sequence HC20. For facility-related handling operations (HF), 14 sequences were identified and are shown in Table 6-1. The applicability of these sequences to the specific munitions stored at each site is also shown in Table 6-1. For clarity, the onsite handling accident sequences (HC) are listed for both the sending site and the receiving site, since differences in agent release dispersion will apply depending on which site the accident occurs.

6.3.1. Human-Reliability Analysis for Handling Operations

A human-reliability analysis (HRA) was performed in support of the handling operations analysis. This section discusses the objective of the HRA, the methodology used, the task analysis performed, the errors described, and the quantification of those errors.

6.3.1.1. Objective. The objective of the human-reliability analysis of the munitions handling operations is to identify, define, and quantify operator errors that could lead to agent release to the environment. The handling operations examined consist of all handling activities at the sending and receiving sites that take place before the demilitarization operations. These include all activities involving loading and unloading munitions, moving munitions with forklifts* and by hand, and packing and unpacking munition pallets. The equipment and personnel involved and the order in which the events occur are based on site visit

*For this study, forklifts and other rubber-tire vehicles performing the same functions as forklifts are referred to as forklifts, and no difference in the error probabilities assigned to these various vehicles is assumed.

TABLE 6-1
LIST OF ACCIDENT SCENARIOS (HC AND HF)
COLLOCATION OPTION - RAIL TRANSPORTATION

	Scenarios Description	Applicable Munition Types	Munition Configuration	
			At Sending Site	At Receiving Site
HC1	Drop of bare pallet or single item at storage area	All	Spray Tank (ST) in overpack	ST in overpack
HC2	Forklift collision with short duration fire at storage area involving bare munitions	TC only	Ton container (TC) only at APG, PBA	Not applicable
HC3	Forklift tine accident involving bare munitions at storage area	All but TC	ST+overpack	ST+overpack at storage area and MHI
HC4	Forklift collision accident without fire at storage area involving bare munitions	All	ST+overpack	ST+overpack
HC5	Drop of onsite container	All	Not applicable	ST+overpack
HC6	Forklift collision with short duration fire during handling of onsite container	All	Not applicable	ST+overpack
HC7	Forklift collision without fire during handling of onsite container	All	Not applicable	ST+overpack
HC8	Drop of offsite container	All	ST+overpack+OFC	ST+overpack+OFC
HC9	Collision accident with short duration fire during handling of offsite container	All	ST+overpack+OFC	ST+overpack+OFC
HC10	Collision accident without fire during handling of offsite container	All	ST+overpack+OFC	ST+overpack+OFC
HC11	Drop of bare palletized munition leads to detonation	Burstered	Pallet	Pallet

TABLE 6-1 (Continued)

	Scenarios Description	Applicable Munition Types	Munition Configuration	
			At Sending Site	At Receiving Site
HC12	Forklift collision accident at storage area leads to detonation of burstered munition	Burstered	Bare	Bare
HC13[a]	Forklift collision accident without fire at maintenance facility	4.2-in. mortar, 105-mm cartridge	Bare	Bare
HC14	Forklift tine accident involving munitions in onsite container	All but TC	Not applicable	ONC
HC17	Drop of pallet containing a leaking munition during leaker isolation operations at LPF	Rockets, bombs[a]	Pallet	Pallet
HC18	Drop of single leaking munition in vapor containment room of leakers processing facility	Rockets, bombs[a]	Bare	Bare
HC19	Forklift tine puncture during leaker isolation operations	Rockets, bombs[a]	Bare	Bare
HC20	Collision accident with short duration fire during handling of leaking munition (munition in pallet)	Rockets, bombs[a]	Pallet	Pallet
HC21	Collision accident without fire during handling of leaker	Rockets, bombs[a]	Bare	Bare

TABLE 6-1 (Continued)

	Scenarios Description	Applicable Munition Types	Munition Configuration	
			At Sending Site	At Receiving Site
HC22	Drop of munition in onsite container leads to detonation	Burstered	Not applicable	ONC
HC23	Drop of munition in offsite container leads to detonation	Burstered	OFC	OFC
HC24	Collision accident during munition handling in onsite container leads to detonation due to impact	Burstered	Not applicable	ONC
HC25	Collision accident during munition handling in offsite container leads to detonation due to impact	Burstered	OFC	OFC
HC26	Collision accident in onsite container with prolonged fire leads to thermal detonation	All	Not applicable	ST+overpack
HC27	Collision accident in offsite container with prolonged fire leads to thermal detonation	All	ST+overpack+OFC	ST+overpack+OFC
HC29	Drop of pallet containing leaker leads to detonation	Rockets[a]	Pallet	Pallet
HC30	Drop of single leaking munition leads to detonation	Rockets[a]	Bare	Bare

TABLE 6-1 (Continued)

	Scenarios Description	Applicable Munition Types	Munition Configuration	
			At Sending Site	At Receiving Site
HC31	Collision accident involving a leaker leads to detonation due to impact	Rockets[a]	Bare	Bare
HC32	Failure to detect a leak in the offsite container	Rockets, bombs[a]	OFC	OFC
HF1	Munition dropped during movement from the MHI to the MDB	All	Not applicable	ST+overpack
HF2	Bare single munition dropped during handling inside the MDB	All	Not applicable	ST without overpack
HF3	Forklift collision accident with short duration fire during handling from MHI to MDB	All	Not applicable	ST+overpack
HF4	Forklift tine accident during handling from MHI to MDB	ST only	Not applicable	ST+overpack
HF5	Forklift collision accident with prolonged fire during handling from MHI to MDB leads to detonation	All	Not applicable	ONC
HF7	Collision accident without fire during movement from the MHI to the MDB	All	Not applicable	ST+overpack
HF8	Munition dropped inside the MDB (in onsite container)	All	Not applicable	ST+overpack
HF9	Forklift tine accident occurs inside the MDB	ST only	Not applicable	ST+overpack
HF10	Forklift collision accident without fire inside the MDB	All	Not applicable	ST+overpack

TABLE 6-1 (Continued)

	Scenarios Description	Applicable Munition Types	Munition Configuration	
			At Sending Site	At Receiving Site
HF11	Munition pallet dropped during movement from the MHI to the MDB leads to detonation	Burstered	Not applicable	ONC
HF12	Bare single munition dropped during handling inside the MDB leads to detonation	Burstered	Not applicable	Bare
HF13	Palletized munition in onsite container dropped during handling inside the MDB leads to detonation	Burstered	Not applicable	Pallet
HF14	Collision accident from MHI to MDB leads to detonation due to impact	Burstered	Not applicable	ONC

(a)Leakers developing during transportation from storage igloo to holding area.

observations, telephone conversations, and reviews of documents including "Transportation of Chemical Agents and Munitions: A Concept Plan" (Ref. 6-1) and the list of GA's handling assumptions (Ref. 6-2).

6.3.1.2. Methodology. The approach used for the human-reliability analysis is similar to the one used for plant operations (described in Plant Operations, Chapter 9). First, a task analysis was performed to identify those errors that could potentially impact agent release probabilities. Those errors were categorized according to the human operations involved; usually, no munition-specific differences were cited. Available data were used to quantify the probabilities of some of these errors, and extrapolations were made from these fixed data to quantify the remainder. Conservative error factors were selected to account for the uncertainty associated with the data, the models, the extrapolations, and site-specifics.

6.3.1.3. Task Analysis. A task analysis was performed to identify credible human errors associated with the handling operations. The sequence of handling events related to rail transport on which this task analysis was based is described in Sections 6.3.2 and 6.3.3. Figures 6-2 and 6-3 schematically represent the various handling steps. Section 9.2 contains the task-analysis table that shows precisely which human errors were identified as applicable to each operation.

All of the handling operations analyzed are performed with forklifts or by hand. Electric forklifts are used inside storage igloos, warehouses, leakers processing facilities, storage facilities, MHIs and MDBs to move single munitions and pallets between the inside of the building and its apron or loading dock. Diesel forklifts are used for moving single munitions, pallets, and transportation containers between the apron or loading docks and trucks and for movement elsewhere outside. Larger forklifts, referred to as container handling equipment (for example, a "piggypacker"), are used to move transport containers (onsite and offsite types). Forklift tines are used to lift pallets and

spray tanks inside their overpacks. Forklift lifting beams are used to lift ton containers and transportation containers.

6.3.1.4. Human-Error Description. Six types of operator errors were identified in the task analysis: (1) puncturing a munition with a forklift tine, (2) dropping a munition or pallet from a forklift, (3) dropping a single munition while hand-carrying it, (4) damaging a munition or munitions in a forklift collision, (5) failing to detect a leaking munition which has developed during transportation, and (6) replacing a ton container valve or plug improperly. These errors are described in the following paragraphs:

1. Puncturing a munition with a forklift tine might occur any time a munition or pallet is approached with a forklift tine. Puncture probability is a function of the human error that results in impact of the tine with the munition and of the vulnerability of the munition to such an impact.

2. Dropping a munition or pallet from a forklift could occur any time a forklift is carrying a load (single munitions, pallets, TCs, spray tanks, package containers, etc.). This action could be caused by operating the forklift in a way that causes the load to fall or by loading the forklift such that the load is misaligned or the weight distribution within the pallet or the package container is unbalanced. It could also result from the pallet's getting caught on and pulled off by something it has run into. Sudden acceleration or deceleration, sharp turns, high-speed operation, or operation over uneven ground could all be contributors to munition drops.

3. Dropping a munition while hand-carrying it may occur any time the munition is picked up, put down, or carried without using a forklift or other lifting device. It could be caused by the

operator's falling as he carries the munition or by the munition's slipping from his grasp.

4. A forklift colliding with another vehicle or with a fixed structure is a credible human-error event, since a human is at the controls at the time of the collision. However, the data available does not distinguish between collisions caused by human error and those caused by mechanical failure. Since the two are accounted for in the collision probability estimate, the human-error factor will not be counted again by quantifying it separately in the human-reliability analysis.

5. Failing to detect that there is a leaking munition in a transportation container is probable every time the operator fails to check the monitor on the container before opening it (since there may or may not be a leaker inside).

6. Improperly replacing a valve or a plug on a TC involves operations that will be conducted before TCs are transported. The TCs frequently have been found to be severely corroded around the brass fill and drain valves and on the threaded plugs installed in the container ends. This replacement is outside the scope of normal plant operation but will be discussed as a separate case in Appendix J.

6.3.1.5. Human Error Probability Estimation. Section 9.2 discusses the human error probability estimation for the handling accidents. Much of the data is based on Ref. 6-4.

6.3.2. Data and Results

Tables 6-2 and 6-3 present the input data used for the accident frequency analysis. The basis for the initiating events frequencies has been discussed in the Human Reliability Analysis Section. Given the

TABLE 6-2
INITIATING EVENTS FREQUENCIES
(HANDLING ASSOCIATED WITH RAIL TRANSPORT)

INITIATING EVENTS FREQUENCIES

	INITIATING EVENT	FREQUENCY EVENTS/OP	ERROR FACTOR	REFERENCE (NOTES)	APPLICABLE SCENARIOS
		(Col.H)	(Col.I)		
HE10	Pallet or single item dropped during handling of non-leaking munition outside the MDB (1)				HC1,HC5,HC8,HC11,HC22,HC23 HF1,HF11
HE10A	Items lifted with tines	3.0E-05	10.0	6,7	
HE10B	Items lifted with lifting beams	3.0E-06	10.0	8	
HE15	Pallet or container dropped during handling of non-leaking munition inside the MDB (2)				HF8,HF13
HE15A	Items lifted with tines	1.5E-04	10.0	7	
HE15B	Items lifted with lifting beams	1.5E-05	10.0	8	
HE20	Pallet or container dropped during handling of leaking munition (3)				HC17,HC29
HE20A	Items lifted with tines	3.0E-04	10.0	7	
HE20B	Items lifted with lifting beams	3.0E-05	10.0	8	
HE25	Single munition dropped inside the MDB (4)	3.0E-04	10.0		HF2,HF12
HE35	Single leaking munition dropped (3)	6.0E-04	10.0		HC18,HC30
HE40	Forklift tine accident involving munition handling outside the MDB (1)	1.0E-05	10.0		HC3,HF4
HE45	Forklift tine accident involving munition handling inside the MDB (2)	5.0E-05	10.0		HF9
HE50	Forklift tine accident involving handling of leaking munition (3)	1.0E-04	10.0		HC19
HE55	Vehicle collision accident	4.3E-06	10.0	GA derive data, see details i Appendix	HC2,HC4,HC6,HC7,HC9,HC10, HC12,HC21,HC24,HC25,HC26, HC27,HC31,HF3,HF5,HF7, HF10,HF14
HE65	Failure to detect a leak in the	1.0E-03	10.0		HC32

TABLE 6-2 (Continued)

transportation container

NOTES:

(1) Handled by forklift or other handling equipment; operators wearing street clothes with mask

(2) Handled by forklift; operators wearing mask, gloves, and boots; excluding ton container

(3) Operators in level A clothing

(4) Handled singly by hand; operators wearing mask, gloves and boots.

(6) 3.0e-5 = 3*10-5

(7) For all items lifted with tines (spray tanks in overpacks and bare munitions)

(8) Items lifted by a lifting beam or by a cargo handling equipment

TABLE 6-3
CONDITIONAL EVENTS PROBABILITIES (RAIL TRANSPORT)

CONDITIONAL EVENTS PROBABILITIES

	EVENT SEQUENCE	EVENT ROBABILIT	ERROR FACTOR	REFERENCE	APPLICABLE SCENARIO
------	--				
HE100	Palletized or single munition punctured given a drop outside the MDB (Drop ht = 6ft.)				HC1,HF1(for SW)
HE100B	Bomb	1.02E-03	3.0	See 6a calc	
HE100D	4.2-in Mortar	2.67E-04	3.0	sheets	
HE100C	105-mm Cartridge	4.73E-05	3.0	(Ref.)	
HE100K	Ton Container	3.34E-03	3.0		
HE100M	Mine (in drums)	2.00E-04	3.0		
HE100P	155-mm Projectile	0.00E+00			
HE100Q	8-in Projectile	0.00E+00			
HE100R	Rocket	7.95E-04	3.0		
HE100SW	Spray Tank (with overpack)	8.63E-03	3.0		
HE110	Offsite container and munition punctured given a drop of the offsite container (4ft drop)				HC8,HF1
HE110B	Bomb	1.93E-03	3.0		
HE110D	4.2-in Mortar	1.02E-03	3.0		
HE110C	105-mm Cartridge	7.30E-04	3.0		
HE110K	Ton Container	1.83E-03	3.0		
HE110M	Mine (in drums)	1.00E-03	3.0		
HE110P	155-mm Projectile	8.40E-04	3.0		
HE110Q	8-in Projectile	8.40E-04	3.0		
HE110R	Rocket	1.06E-03	3.0		
HE110SW	Spray Tank (with overpack)	7.10E-04	3.0		
HE120	Container and munition punctured given drop of the offsite container (2ft drop)				HC9,HC10
HE120B	Bomb	1.38E-03	3.0		
HE120D	4.2-in Mortar	8.60E-04	3.0		
HE120C	105-mm Cartridge	4.20E-04	3.0		
HE120K	Ton Container	1.10E-03	3.0		
HE120M	Mine (in drums)	8.50E-04	3.0		
HE120P	155-mm Projectile	2.00E-04	3.0		
HE120Q	8-in Projectile	2.00E-04	3.0		

TABLE 6-3 (Continued)

HE120R	Rocket	9.00E-04	3.0	
HE120SW	Spray Tank (with overpack)	4.40E-04	3.0	
HE140	Palletized or single munition punctured given a drop resulting from collision (Drop ht = 2ft.)			HC2,HC4,HC21 HF3,HF7,HF10 (SW only)
HE140B	Bomb	3.94E-04	3.0	
HE140D	4.2-in Mortar	1.87E-04	3.0	
HE140C	105-mm Cartridge	4.57E-06	3.0	
HE140K	Ton Container	1.68E-03	3.0	
HE140M	Mine (in drums)	1.60E-04	3.0	
HE140P	155-mm Projectile	0.00E+00		
HE140Q	8-in Projectile	0.00E+00		
HE140R	Rocket	7.16E-04	3.0	
HE140SW	Spray Tank (with overpack)	6.31E-03	3.0	
HE150	Palletized munition in onsite container puncture given a drop of container (Drop ht = 4ft., also applies to handling in UPA)			HF8, HC5
HE150B	Bomb	3.50E-04	3.0	
HE150D	4.2-in Mortar	3.50E-04	3.0	
HE150C	105-mm Cartridge	4.00E-05	3.0	
HE150K	Ton Container	7.20E-04	3.0	
HE150M	Mine (in drums)	4.80E-04	3.0	
HE150P	155-mm Projectile	6.00E-05	3.0	
HE150Q	8-in Projectile	6.00E-05	3.0	
HE150R	Rocket	2.70E-04	3.0	
HE160	Palletized or single munition in onsite container punctured given drop resulting from collision (2ft drop)			HC6,HC7
HE160B	Bomb	1.00E-04	3.0	
HE160D	4.2-in Mortar	3.00E-04	3.0	
HE160C	105-mm Cartridge	0.00E+00		
HE160K	Ton Container	3.30E-04	3.0	
HE160M	Mine (in drums)	4.40E-04	3.0	
HE160P	155-mm Projectile	0.00E+00		
HE160Q	8-in Projectile	0.00E+00		
HE160R	Rocket	2.60E-04	3.0	

TABLE 6-3 (Continued)

HE250	Single bare munition punctured given drop in UPA (Drop ht = 4ft.)				HF2, HF8 (HE250SW)
HE250B	Bomb	3.50E-04	3.0		
HE250D	4.2-in Mortar	0.00E+00			
HE250C	105-mm Cartridge	0.00E+00			
HE250K	Ton Container	2.80E-03	3.0		
HE250M	Mine (in drums)	8.82E-05	3.0		
HE250P	155-mm Projectile	0.00E+00			
HE250Q	8-in Projectile	0.00E+00			
HE250R	Rocket	5.93E-04	3.0		
HE250SD	Spray Tank (no overpack)	1.51E-02	3.0		
HE250SW	Spray Tank (with overpack)	7.87E-03	3.0		
HE400	Munition punctured by forklift tines				HC3,HC19,HF4 (SW) HF9 (SW)
HE400B	Bomb	1.29E-02	3.0		
HE400D	4.2-in Mortar	3.68E-02	3.0		
HE400C	105-mm Cartridge	8.90E-03	3.0		
HE400K	Ton Container	N/A	3.0		
HE400M	Mine (in drums)	7.07E-02	3.0		
HE400P	155-mm Projectile	5.00E-03	3.0		
HE400Q	8-in Projectile	5.00E-03	3.0		
HE400R	Rocket	2.63E-01	3.0		
HE400SW	Spray Tank (with overpack)	1.53E-02	3.0		
HE550	Fire results from vehicle collision	7.25E-02	10.0	See App F	HC2,HC6,HC9, HC26,HC27,HF3,HF5
HE555	Collision does not cause fire	9.27E-01	none	See App F	HC7,HC10, HF7
HE560	Fire contained				HC2,HC6,HC9,HF3
HE560A	4 min - Burstered munitions	5.00E-01	none		
HE560B	30 min - Non burstered munitions	1.00E+00	none		
HE560C	>15 min - On/Offsite container	1.00E+00	none		
HE570	Fire not contained				HC26,HC27,HF5
HE570A	4 min - Burstered munitions	5.00E-01	none		
HE570B	30 min - Non burstered munitions	0.00E+00	none		

TABLE 6-3 (Continued)

HE570C	>15 min - On/Offsite container	0.00E+00	none	
HE590	Munition in on/offsite container detonates or ruptures given prolonged fire (>15 min)	1.00E+00	none	HC26,HC27,HF5
HE600	Munition detonates given drop (6ft) or collision (per munition)	9.50E-09		HC11,HC12 HC29,HC30,HC31 (R)
HE600D	4.2-in Mortar (48)	4.56E-07	10.0	
HE600C	105-mm Cartridge (24)	2.28E-07	10.0	
HE600M	Mine (in drums) (36)	3.42E-07	10.0	
HE600P	155-mm Projectile (8)	7.60E-08	10.0	
HE600Q	8-in Projectile (6)	5.70E-08	10.0	
HE600R	Rocket (15)	1.43E-07	10.0	
HE620	Single bare munition detonates given 4 ft drop (in UPA)	3.20E-10	10.0	HF12
HE700	Munition in onsite container detonates given drop (per munition)	3.20E-11		HC22,HC24, HF11,HF13,HF14
HE700D	4.2-in Mortar (48)	1.54E-09	10.0	
HE700C	105-mm Cartridge (24)	7.68E-10	10.0	
HE700M	Mine (in drums) (36)	1.15E-09	10.0	
HE700P	155-mm Projectile (8)	2.56E-10	10.0	
HE700Q	8-in Projectile (6)	1.92E-10	10.0	
HE700R	Rocket (15)	4.80E-10	10.0	
HE710	Munition in offsite container detonates given drop (per munition)	3.20E-12		HC23,HC25
HE710D	4.2-in Mortar (48)	6.14E-10	10.0	
HE710C	105-mm Cartridge (24)	9.22E-10	10.0	
HE710M	Mine (in drums) (36)	3.46E-10	10.0	
HE710P	155-mm Projectile (8)	3.84E-10	10.0	
HE710Q	8-in Projectile (6)	1.92E-10	10.0	
HE710R	Rocket (15)	1.92E-10	10.0	
HE800	MDB Ventilation System Failure	1.00E-09	10.0	HC17,HC18,HC19,HC21 HF2, HF8,HF9,HF10

initiating event, additional events have to occur to cause an agent release to the environment. The mechanisms for release could be the breaching of munitions by puncture, impact, or detonation because of some undue force. If the accident involves a fire (e.g., collisions), thermal detonation of burstered munitions or hydraulic rupture of non-burstered munitions is possible if the fire is not suppressed. For accidents which occur in the leakers processing facility or in the UPA (some HF scenarios), failure of the ventilation system is critical to the amount of agent released to the environment.

Puncture Probability. The probability of puncturing a munition whether it is inside or outside a transportation container has been evaluated based on a puncture model that is a function of the probe density and length, the possible number of such probes in the area, the munition size and configuration, and drop height. Details of this model are discussed in Appendix C.

Munition Detonation. The probability of a bare munition detonating when dropped from a height of 6 ft (equivalent to a collision at 13.5 mph) is assumed to be 9.5×10^{-9}/munition. For a 4-ft drop, the corresponding probability is 3.2×10^{-10}. The probability of a munition inside a transportation container detonating when dropped is judged to be lower. Here we take credit for the cushioning effect provided by the dunnage and packaging material inside the container. We assume that this will essentially reduce the impact velocity experienced by the munition itself by 30%, thus reducing the impact velocity to 9.5 mph. Using the approach outlined in Appendix C of Ref. 6-3, this results in a probability of 3.2×10^{-11}/munition for the onsite container and 3.2×10^{-12} for the offsite container.

Collision Leads to Fire. The probability value of 0.0725 was derived from Ref. 6-3, which presents data indicating that 25% of collision accidents lead to fire and 29% of collision accidents occur at

20 mph or less. This is the assumed maximum speed of the forklift during a collision.

Fire Contained. The amount of available fuel in any transportation vehicle will be limited such that it cannot sustain a prolonged fire (greater than a few minutes). For nonburstered munitions that are not in transportation containers, it takes 30 min of direct heating before hydraulic rupture occurs (36 min for ton containers). Since the available fuel will be insufficient to support this fire duration, the probability of fire containment is 1.0. When munitions are in transportation containers, it takes at least 15 min of direct heating of an intact container to cause a thermal explosion. Again the available fuel will not be sufficient to support this fire. Hence, the probability of fire containment is also 1.0.

The results of the handling analysis are presented in Section 11 of this report. Table 6-4 summarizes the results of the frequency and uncertainty calculations for rail transport handling. Frequency results are median values.

TABLE 6-4
HANDLING ACCIDENT-COLLOCATION PROCESSING OPTION (RAIL TRANSPORT)

File: HDLREGST.WK1 17-Aug-87 Page 1

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

Accident Frequencies and Range Factors

SCEN-ARIO	OP.	NO.	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCBGC		1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-07	1.3E+01	6.1E-08	1.3E+01
HCDHC		1	3.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	1.3E+01	3.2E-08	1.3E+01	N/A	--
HCCGC		1	5.7E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.7E-09	1.3E+01	N/A	--
HCCHC		1	5.7E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-09	1.3E+01	5.7E-09	1.3E+01	N/A	--
HCKGC		1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.0E-08	1.3E+01	N/A	--
HCKHC		1	4.0E-08	1.3E+01	2.0E-08	1.3E+01	N/A	--	N/A	--	2.0E-08	1.3E+01	N/A	--	4.0E-08	1.3E+01	2.0E-08	1.3E+01
HCKVC		1	4.0E-08	1.3E+01	N/A	--	N/A	--	2.0E-08	1.3E+01	N/A	--	N/A	--	4.0E-08	1.3E+01	N/A	--
HCMVC		1	2.4E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	2.4E-08	1.3E+01	1.2E-08	1.3E+01
HCPGC		1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCPHC		1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--
HCPVC		1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCQGC		1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCQVC		1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCRGC		1	9.5E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	9.5E-08	1.3E+01	4.8E-08	1.3E+01
HCRVC		1	9.5E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	9.5E-08	1.3E+01	4.8E-08	1.3E+01
HCSVC		1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-06	1.3E+01	5.2E-07	1.3E+01
HCKHF		2	N/A	--	5.2E-10	3.1E+01	N/A	--	N/A	--	5.2E-10	3.1E+01	N/A	--	5.2E-10	3.1E+01	N/A	-
HCBGC		3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-07	1.3E+01	1.3E-07	1.3E+01
HCDHC		3	7.4E-07	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.7E-07	1.3E+01	7.4E-07	1.3E+01	N/A	--
HCCGC		3	1.8E-07	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-07	1.3E+01	N/A	--
HCCHC		3	1.8E-07	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.9E-08	1.3E+01	1.8E-07	1.3E+01	N/A	--
HCMVC		3	1.4E-06	1.3E+01	N/A	--	N/A	--	N/A	--	7.1E-07	1.3E+01	N/A	--	1.4E-06	1.3E+01	7.1E-07	1.3E+01
HCPGC		3	1.0E-07	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01
HCPHC		3	1.0E-07	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	5.0E-08	1.3E+01	1.0E-07	1.3E+01	N/A	--
HCPVC		3	1.0E-07	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01
HCQGC		3	1.0E-07	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01
HCQVC		3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01
HCRGC		3	5.3E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	5.3E-06	1.3E+01	2.6E-06	1.3E+01
HCRVC		3	5.3E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	5.3E-06	1.3E+01	2.6E-06	1.3E+01

File: HDLREGST.WK1 17-Aug-87 Page 2

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

Accident Frequencies and Range Factors

SCEN-ARIO	OF.	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCSVC		3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.1E-07	1.3E+01	1.5E-07	1.3E+01
HCBGC		4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	1.7E-09	1.3E+01
HCDHC		4	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.0E-10	1.3E+01	1.6E-09	1.3E+01	N/A	--
HCCGC		4	3.9E-11	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-11	1.3E+01	N/A	--
HCCHC		4	3.9E-11	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-11	1.3E+01	3.9E-11	1.3E+01	N/A	--
HCKGC		4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	1.3E+01	N/A	--
HCKHC		4	1.4E-08	1.3E+01	6.7E-09	1.3E+01	N/A	--	N/A	--	6.7E-09	1.3E+01	N/A	--	1.4E-08	1.3E+01	7.2E-09	1.3E+01
HCKVC		4	1.4E-08	1.3E+01	N/A	--	N/A	--	7.2E-09	1.3E+01	N/A	--	N/A	--	1.4E-08	1.3E+01	N/A	--
HCMVC		4	1.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	6.9E-10	1.3E+01	N/A	--	1.4E-09	1.3E+01	6.9E-10	1.3E+01
HCFGC		4	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCFHC		4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--
HCFVC		4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCQGC		4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCQVC		4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCRGC		4	6.2E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	6.2E-09	1.3E+01	3.1E-09	1.3E+01
HCRVC		4	6.2E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	6.2E-09	1.3E+01	3.1E-09	1.3E+01
HCSVC		4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-08	1.3E+01	2.7E-08	1.3E+01
HCBGS		5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.3E-09	1.3E+01	N/A	-
HCDHS		5	6.3E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.3E-09	1.3E+01	N/A	-
HCCGS		5	7.2E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HCCHS		5	7.2E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HCKGS		5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--
HCKHS		5	1.3E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--
HCKVS		5	1.3E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--
HCMVS		5	8.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--
HCFGS		5	1.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--
HCFHS		5	1.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--
HCFVS		5	1.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--
HCQGS		5	1.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--

File: HDLREGST.WK1 17-Aug-87 Page 3

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

Accident Frequencies and Range Factors

SCEN-ARIO	OP.	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCQVS		5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--
HCRGS		5	4.9E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.9E-09	1.3E+01	N/A	--
HCRVS		5	4.9E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.9E-09	1.3E+01	N/A	--
HCSVS		5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-07	1.3E+01	N/A	--
HCBGF		6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.2E-11	3.1E+01	N/A	--
HCDHF		6	1.9E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--
HCCGF		6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCCHF		6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCKGF		6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--
HCKHF		6	2.1E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--
HCKVF		6	2.1E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--
HCMVF		6	2.7E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-10	3.1E+01	N/A	--
HCPGF		6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCPHF		6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCPVF		6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCQGF		6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCQVF		6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCRGF		6	1.6E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	3.1E+01	N/A	--
HCRVF		6	1.6E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	3.1E+01	N/A	--
HCSVF		6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-09	3.1E+01	N/A	--
HCBGS		7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.7E-09	1.3E+01	N/A	--
HCDHS		7	1.1E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-08	1.3E+01	N/A	--
HCCGS		7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCCHS		7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCKGS		7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--
HCKHS		7	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--
HCKVS		7	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--
HCMVS		7	1.6E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	1.3E+01	N/A	--
HCPGS		7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--

File: HDLREGST.WK1   17-Aug-87   Page 4

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

Accident Frequencies and Range Factors

SCEN-ARIO	OP.	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCPHS		7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCPVS		7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCQGS		7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCQVS		7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCRGS		7	9.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-09	1.3E+01	N/A	--
HCRVS		7	9.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-09	1.3E+01	N/A	--
HCSVS		7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-07	1.3E+01	N/A	--
HCBGS		8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-08	1.3E+01	2.3E-08	1.3E+01
HCDHS		8	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	1.2E-08	1.3E+01	N/A	--
HCCGS		8	8.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.8E-09	1.3E+01	N/A	--
HCCHS		8	8.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.8E-09	1.3E+01	8.8E-09	1.3E+01	N/A	--
HCKGS		8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--
HCKHS		8	2.2E-08	1.3E+01	2.2E-08	1.3E+01	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--	2.2E-08	1.3E+01	2.2E-08	1.3E+01
HCKVS		8	2.2E-08	1.3E+01	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--
HCMVS		8	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	1.2E-08	1.3E+01	1.2E-08	1.3E+01
HCFGS		8	1.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01
HCFHS		8	1.0E-08	1.3E+01	N/A	--	1.0E-08	1.3E+01	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01	N/A	--
HCPVS		8	1.0E-08	1.3E+01	N/A	--	1.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01
HCQGS		8	1.0E-08	1.3E+01	N/A	--	1.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01
HCQVS		8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01
HCRGS		8	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	1.3E-08	1.3E+01
HCRVS		8	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	1.3E-08	1.3E+01
HCSVS		8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.5E-09	1.3E+01	8.5E-09	1.3E+01
HCBGF		9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-10	3.1E+01	8.6E-10	3.1E+01
HCDHF		9	5.4E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-10	3.1E+01	5.4E-10	3.1E+01	N/A	--
HCCGF		9	2.6E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-10	3.1E+01	N/A	--
HCCHF		9	2.6E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-10	3.1E+01	2.6E-10	3.1E+01	N/A	--
HCKGF		9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--
HCKHF		9	6.9E-10	3.1E+01	6.9E-10	3.1E+01	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--	6.9E-10	3.1E+01	6.9E-10	3.1E+01

File: HDLREGST.WK1 17-Aug-87 Page 5

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

Accident Frequencies and Range Factors

SCEN-ARIO	OF. NO.	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCKVF	9	6.9E-10	3.1E+01	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--
HCMVF	9	5.3E-10	3.1E+01	N/A	--	N/A	--	N/A	--	5.3E-10	3.1E+01	N/A	--	5.3E-10	3.1E+01	5.3E-10	3.1E+01
HCFGF	9	1.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01
HCPHF	9	1.2E-10	3.1E+01	N/A	--	1.2E-10	3.1E+01	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01	N/A	--
HCPVF	9	1.2E-10	3.1E+01	N/A	--	1.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01
HCQGF	9	1.2E-10	3.1E+01	N/A	--	1.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01
HCQVF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01
HCRGF	9	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	5.6E-10	3.1E+01
HCRVF	9	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	5.6E-10	3.1E+01
HCSVF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-10	3.1E+01	2.7E-10	3.1E+01
HCEGS	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-08	1.3E+01	1.1E-08	1.3E+01
HCDHS	10	6.9E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	6.9E-09	1.3E+01	6.9E-09	1.3E+01	N/A	--
HCCGS	10	3.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	N/A	--
HCCHS	10	3.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	3.4E-09	1.3E+01	N/A	--
HCKGS	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.8E-09	1.3E+01	N/A	--
HCKHS	10	8.8E-09	1.3E+01	8.8E-09	1.3E+01	N/A	--	N/A	--	8.8E-09	1.3E+01	N/A	--	8.8E-09	1.3E+01	8.8E-09	1.3E+01
HCKVS	10	8.8E-09	1.3E+01	N/A	--	N/A	--	8.8E-09	1.3E+01	N/A	--	N/A	--	8.8E-09	1.3E+01	N/A	--
HCMVS	10	6.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	6.8E-09	1.3E+01	N/A	--	6.8E-09	1.3E+01	6.8E-09	1.3E+01
HCFGS	10	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01
HCPHS	10	1.6E-09	1.3E+01	N/A	--	1.6E-09	1.3E+01	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01	N/A	--
HCPVS	10	1.6E-09	1.3E+01	N/A	--	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01
HCQGS	10	1.6E-09	1.3E+01	N/A	--	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01
HCQVS	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01
HCRGS	10	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	7.2E-09	1.3E+01
HCRVS	10	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	7.2E-09	1.3E+01
HCSVS	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-09	1.3E+01	3.5E-09	1.3E+01
HCDHC	11	5.8E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-09	2.6E+01	5.8E-09	2.6E+01	N/A	--
HCCGC	11	2.9E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-09	2.6E+01	N/A	--
HCCHC	11	2.9E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-09	2.6E+01	2.9E-09	2.6E+01	N/A	--

File: HDLREGST.WK1 · 17-Aug-87 Page 6

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

Accident Frequencies and Range Factors

SCEN-ARIO	OP.	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCMVC		11	4.3E-09	2.6E+01	N/A	--	N/A	--	N/A	--	2.2E-09	2.6E+01	N/A	--	4.3E-09	2.6E+01	2.2E-09	2.6E+01
HCFGC		11	9.6E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-10	2.6E+01	4.8E-10	2.6E+01
HCFHC		11	9.6E-10	2.6E+01	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	4.8E-10	2.6E+01	9.6E-10	2.6E+01	N/A	--
HCFVC		11	9.6E-10	2.6E+01	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	N/A	--	9.6E-10	2.6E+01	4.8E-10	2.6E+01
HCQGC		11	7.2E-10	2.6E+01	N/A	--	3.6E-10	2.6E+01	N/A	--	N/A	--	N/A	--	7.2E-10	2.6E+01	3.6E-10	2.6E+01
HCQVC		11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	2.6E+01	3.6E-10	2.6E+01
HCRGC		11	1.8E-09	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	1.8E-09	2.6E+01	9.0E-10	2.6E+01
HCRVC		11	1.8E-09	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	1.8E-09	2.6E+01	9.0E-10	2.6E+01
HCDHC		12	4.1E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	2.6E+01	4.1E-10	2.6E+01	N/A	--
HCCGC		12	2.1E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	2.6E+01	N/A	--
HCCHC		12	2.1E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	2.6E+01	2.1E-10	2.6E+01	N/A	--
HCMVC		12	3.1E-10	2.6E+01	N/A	--	N/A	--	N/A	--	1.5E-10	2.6E+01	N/A	--	3.1E-10	2.6E+01	1.5E-10	2.6E+01
HCFGC		12	6.9E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.9E-11	2.6E+01	3.4E-11	2.6E+01
HCFHC		12	6.9E-11	2.6E+01	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	3.4E-11	2.6E+01	6.9E-11	2.6E+01	N/A	--
HCFVC		12	6.9E-11	2.6E+01	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.9E-11	2.6E+01	3.4E-11	2.6E+01
HCQGC		12	5.2E-11	2.6E+01	N/A	--	2.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	5.2E-11	2.6E+01	2.6E-11	2.6E+01
HCQVC		12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-11	2.6E+01	2.6E-11	2.6E+01
HCRGC		12	1.3E-10	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	1.3E-10	2.6E+01	6.5E-11	2.6E+01
HCRVC		12	1.3E-10	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	1.3E-10	2.6E+01	6.5E-11	2.6E+01
HCBGC		17	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E-13	2.6E+01	6.0E-13	2.6E+01
HCRGC		17	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	6.0E-13	2.6E+01
HCRVC		17	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	6.0E-13	2.6E+01
HCBGC		18	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-12	2.6E+01	1.2E-12	2.6E+01
HCRGC		18	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	1.2E-12	2.6E+01
HCRVC		18	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	1.2E-12	2.6E+01
HCBGC		19	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-15	3.1E+01	2.6E-15	3.1E+01
HCRGC		19	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	2.6E-14	3.1E+01
HCRVC		19	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	2.6E-14	3.1E+01
HCBGC		21	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-18	3.1E+01	3.4E-18	3.1E+01

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

Accident Frequencies and Range Factors

SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCRGC	21	3.1E-18	3.1E+01	N/A	--	3.1E-18	3.1E+01	N/A	--	3.1E-18	3.1E+01	N/A	--	3.1E-18	3.1E+01	3.1E-18	3.1E+01
HCRVC	21	3.1E-18	3.1E+01	N/A	--	3.1E-18	3.1E+01	N/A	--	3.1E-18	3.1E+01	N/A	--	3.1E-18	3.1E+01	3.1E-18	3.1E+01
HCDHC	22	8.7E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.7E-11	2.6E+01	N/A	--
HCCGC	22	4.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--
HCCHC	22	4.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--
HCMVC	22	6.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--
HCPGC	22	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--
HCPHC	22	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--
HCPVC	22	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--
HCQGC	22	1.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--
HCQVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--
HCRGC	22	2.7E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-11	2.6E+01	N/A	--
HCRVC	22	2.7E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-11	2.6E+01	N/A	--
HCDHC	23	2.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-11	2.6E+01	2.3E-11	2.6E+01	N/A	--
HCCGC	23	3.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-11	2.6E+01	N/A	--
HCCHC	23	3.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-11	2.6E+01	3.5E-11	2.6E+01	N/A	--
HCMVC	23	1.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.3E-11	2.6E+01	N/A	--	1.3E-11	2.6E+01	1.3E-11	2.6E+01
HCPGC	23	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01
HCPHC	23	1.4E-11	2.6E+01	N/A	--	1.4E-11	2.6E+01	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01	N/A	--
HCPVC	23	1.4E-11	2.6E+01	N/A	--	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01
HCQGC	23	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01
HCQVC	23	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01
HCRGC	23	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E 12	2.6E+01	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01
HCRVC	23	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01
HCDHC	24	6.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.2E-11	2.6E+01	N/A	--
HCCGC	24	3.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	2.6E+01	N/A	--
HCCHC	24	3.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	2.6E+01	N/A	--
HCMVC	24	4.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.6E-11	2.6E+01	N/A	--
HCPGC	24	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--

File: HDLREGST.WK1 17-Aug-87 Page 8

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

Accident Frequencies and Range Factors

SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCFHC	24	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--
HCFVC	24	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--
HCQGC	24	7.7E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--
HCQVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--
HCRGC	24	1.9E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-11	2.6E+01	N/A	--
HCRVC	24	1.9E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-11	2.6E+01	N/A	--
HCDHC	25	1.7E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	2.6E+01	1.7E-11	2.6E+01	N/A	--
HCCGC	25	2.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.5E-11	2.6E+01	N/A	--
HCCHC	25	2.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.5E-11	2.6E+01	2.5E-11	2.6E+01	N/A	--
HCMVC	25	9.3E-12	2.6E+01	N/A	--	N/A	--	N/A	--	9.3E-12	2.6E+01	N/A	--	9.3E-12	2.6E+01	9.3E-12	2.6E+01
HCFGC	25	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01
HCFHC	25	1.0E-11	2.6E+01	N/A	--	1.0E-11	2.6E+01	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01	N/A	--
HCFVC	25	1.0E-11	2.6E+01	N/A	--	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01
HCQGC	25	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01
HCQVC	25	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01
HCRGC	25	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01
HCRVC	25	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01
HCBGF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCDHC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCCGC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCCHC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCKGF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCKHF	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCKVF	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCMVC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCFGC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCFHC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCFVC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCQGC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

Accident Frequencies and Range Factors

SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCQVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCRGC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCRVC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCSVF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCBGF	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCDHC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--
HCCGC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCCHC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--
HCKGF	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCKHF	27	0.0E+00	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--
HCKVF	27	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCMVC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--
HCFGC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCFHC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--
HCFVC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCQGC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCQVC	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCRGC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--
HCRVC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--
HCSVF	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCRGC	29	9.0E-07	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	9.0E-09	2.6E+01
HCRVC	29	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	9.0E-09	2.6E+01
HCRGC	30	1.8E-09	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	1.8E-08	2.6E+01
HCRVC	30	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	1.8E-08	2.6E+01
HCRGC	31	6.5E-11	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	6.5E-11	2.6E+01	1.3E-10	2.6E+01
HCRVC	31	6.5E-11	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	6.5E-11	2.6E+01	1.3E-10	2.6E+01
HCFGS	32	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-03	1.0E+01	1.0E-03	1.0E+01
HCRGS	32	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	1.0E-03	1.0E+01
HCRVS	32	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	1.0E-03	1.0E+01

File: HFREG.WK1 Page 1 Date 20-Aug-87

TABLE 6-4 (Continued)

REGIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HFBGS	1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E-09	1.3E+01	N/A	--
HFDHS	1	4.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E-09	1.3E+01	N/A	--
HFCGS	1	4.8E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-10	1.3E+01	N/A	--
HFCHS	1	4.8E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-10	1.3E+01	N/A	--
HFKGS	1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--
HFKHS	1	8.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--
HFKVS	1	8.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--
HFMVS	1	5.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.8E-09	1.3E+01	N/A	--
HFFGS	1	7.2E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HFFHS	1	7.2E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HFFVS	1	7.2E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HFQGS	1	7.2E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HFQVS	1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HFRGS	1	3.2E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	1.3E+01	N/A	--
HFRVS	1	3.2E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	1.3E+01	N/A	--
HFSVS	1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-06	1.3E+01	N/A	--
HFBGC	2	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-16	3.1E+01	N/A	--
HFDHC	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCGC	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCHC	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKGC	2	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.4E-16	3.1E+01	N/A	--
HFKHC	2	8.4E-16	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.4E-16	3.1E+01	N/A	--
HFKVC	2	8.4E-16	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.4E-16	3.1E+01	N/A	--
HFMVC	2	2.6E-17	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-17	3.1E+01	N/A	--
HFFGC	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFFHC	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFFVC	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQGS	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQVS	2	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--

File: HFREG.WK1 Page 2 Date 20-Aug-87

TABLE 6-4 (Continued)

REGIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAF FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HFRGC	2	1.8E-16	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-16	3.1E+01	N/A	--
HFRVC	2	1.8E-16	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-16	3.1E+01	N/A	--
HFSVC	2	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.5E-15	3.1E+01	N/A	--
HFBGF	3	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	3.1E+01	N/A	--
HFDHF	3	9.4E-11	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.4E-11	3.1E+01	N/A	--
HFCGF	3	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCHF	3	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKGF	3	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	3.1E+01	N/A	--
HFKHF	3	1.0E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	3.1E+01	N/A	--
HFKVF	3	1.0E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	3.1E+01	N/A	--
HFMVF	3	1.4E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-10	3.1E+01	N/A	--
HFPGF	3	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPHF	3	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPVF	3	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQGF	3	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQVF	3	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFRGF	3	8.1E-11	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.1E-11	3.1E+01	N/A	--
HFRVF	3	8.1E-11	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.1E-11	3.1E+01	N/A	--
HFSVF	3	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-09	3.1E+01	N/A	--
HFSVS	4	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-07	1.3E+01	N/A	--
HFBGF	5	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFDHC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCGC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCHC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKGF	5	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKHF	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKVF	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFMVC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPGC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--

File: HFREG.WK1 Page 3 Date 20-Aug-87

TABLE 6-4 (Continued)

REGIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HFPHC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPVC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQGC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQVC	5	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFRGC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFRVC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFSVF	5	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFBGS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.3E-10	1.3E+01	N/A	--
HFDHS	7	2.5E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.5E-09	1.3E+01	N/A	--
HFCGS	7	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCHS	7	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKGS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-09	1.3E+01	N/A	--
HFKHS	7	2.7E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-09	1.3E+01	N/A	--
HFKVS	7	2.7E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-09	1.3E+01	N/A	--
HFMVS	7	3.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-09	1.3E+01	N/A	--
HFFGS	7	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFFHS	7	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPVS	7	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQGS	7	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQVS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFRGS	7	2.2E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	1.3E+01	N/A	--
HFRVS	7	2.2E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	1.3E+01	N/A	--
HFSVS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	1.3E+01	N/A	--
HFBGC	8	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.3E-18	3.1E+01	N/A	--
HFDHC	8	5.3E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.3E-18	3.1E+01	N/A	--
HFCGC	8	6.0E-19	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E-19	3.1E+01	N/A	--
HFCHC	8	6.0E-19	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E-19	3.1E+01	N/A	--
HFKGC	8	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-17	3.1E+01	N/A	--
HFKHC	8	1.1E-17	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-17	3.1E+01	N/A	--

File: HFREG.WK1 Page 4 Date 20-Aug-87

TABLE 6-4 (Continued)

REGIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HFKVC	8	1.1E-17	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-17	3.1E+01	N/A	--
HFMVC	8	7.2E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-18	3.1E+01	N/A	--
HFPGC	8	9.0E-19	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--
HFPHC	8	9.0E-19	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--
HFPVC	8	9.0E-19	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--
HFQGC	8	9.0E-19	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--
HFQVC	8	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--
HFRGC	8	4.1E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-18	3.1E+01	N/A	--
HFRVC	8	4.1E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-18	3.1E+01	N/A.	--
HFSVC	8	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-15	3.1E+01	N/A	--
HFSVC	9	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-16	3.1E+01	N/A	--
HFBGC	10	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-19	3.1E+01	N/A	--
HFDHC	10	1.3E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-18	3.1E+01	N/A	--
HFCGC	10	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCHC	10	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKGC	10	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-18	3.1E+01	N/A	--
HFKHC	10	1.4E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-18	3.1E+01	N/A	--
HFKVC	10	1.4E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-18	3.1E+01	N/A	--
HFMVC	10	1.9E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-18	3.1E+01	N/A	--
HFPGC	10	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPHC	10	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPVC	10	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQGC	10	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQVC	10	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFRGC	10	1.1E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-18	3.1E+01	N/A	--
HFRVC	10	1.1E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-18	3.1E+01	N/A	--
HFSVC	10	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-17	3.1E+01	N/A	--
HFDHC	11	5.8E-11	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.8E-11	2.6E+01	N/A	--
HFCGC	11	2.9E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-11	2.6E+01	N/A	--

File: HFREG.WK1 Page 5 Date 20-Aug-87

TABLE 6-4 (Continued)

REGIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HFCHC	11	2.9E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-11	2.6E+01	N/A	--
HFMVC	11	4.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--
HFFGC	11	9.6E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-12	2.6E+01	N/A	--
HFFHC	11	9.6E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-12	2.6E+01	N/A	--
HFPVC	11	9.6E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-12	2.6E+01	N/A	--
HFQGC	11	7.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	N/A	--
HFQVC	11	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	N/A	--
HFRGC	11	1.8E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-11	2.6E+01	N/A	--
HFRVC	11	1.8E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-11	2.6E+01	N/A	--
HFDHC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFCGC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFCHC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFMVC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFFGC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFFHC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFFVC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFQGC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFQVC	12	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFRGC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFRVC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFDHC	13	7.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-11	2.6E+01	N/A	--
HFCGC	13	3.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-11	2.6E+01	N/A	--
HFCHC	13	3.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-11	2.6E+01	N/A	--
HFMVC	13	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
HFFGC	13	1.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-11	2.6E+01	N/A	--
HFFHC	13	1.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-11	2.6E+01	N/A	--
HFFVC	13	1.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-11	2.6E+01	N/A	--
HFQGC	13	9.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-12	2.6E+01	N/A	--
HFQVC	13	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-12	2.6E+01	N/A	--

File: HFREG.WK1 Page 6 Date 20-Aug-87

TABLE 6-4 (Continued)

REGIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HFRGC	13	2.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--
HFRVC	13	2.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--
HFDHC	14	1.3E-14	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-14	2.6E+01	N/A	--
HFCGC	14	6.6E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.6E-15	2.6E+01	N/A	--
HFCHC	14	6.6E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.6E-15	2.6E+01	N/A	--
HFMVC	14	9.9E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.9E-15	2.6E+01	N/A	--
HFPGC	14	2.2E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-15	2.6E+01	N/A	--
HFPHC	14	2.2E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-15	2.6E+01	N/A	--
HFPVC	14	2.2E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-15	2.6E+01	N/A	--
HFQGC	14	1.7E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-15	2.6E+01	N/A	--
HFQVC	14	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-15	2.6E+01	N/A	--
HFRGC	14	4.1E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-15	2.6E+01	N/A	--
HFRVC	14	4.1E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-15	2.6E+01	N/A	--

File: HDLNAT.WK1, Page 1 Date 18-Aug-87

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

Accident Frequencies and Range Factors

SCEN-ARIO	OF. NO.	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCBGC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-07	1.3E+01	6.1E-08	1.3E+01
HCDHC	1	1.6E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	1.3E+01	3.2E-08	1.3E+01	N/A	--
HCCGC	1	2.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.7E-09	1.3E+01	N/A	--
HCCHC	1	2.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-09	1.3E+01	5.7E-09	1.3E+01	N/A	--
HCKGC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.0E-08	1.3E+01	N/A	--
HCKHC	1	2.0E-08	1.3E+01	2.0E-08	1.3E+01	N/A	--	N/A	--	2.0E-08	1.3E+01	N/A	--	4.0E-08	1.3E+01	2.0E-08	1.3E+01
HCKVC	1	N/A	--	N/A	--	N/A	--	2.0E-08	1.3E+01	N/A	--	N/A	--	4.0E-08	1.3E+01	N/A	--
HCMVC	1	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	2.4E-08	1.3E+01	1.2E-08	1.3E+01
HCFGC	1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCFHC	1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--
HCFVC	1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCQGC	1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCQVC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCRGC	1	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	9.5E-08	1.3E+01	4.8E-08	1.3E+01
HCRVC	1	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	9.5E-08	1.3E+01	4.8E-08	1.3E+01
HCSVC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-06	1.3E+01	5.2E-07	1.3E+01
HCKHF	2	N/A	--	5.2E-10	3.1E+01	N/A	--	N/A	--	5.2E-10	3.1E+01	N/A	--	5.2E-10	3.1E+01	N/A	--
HCBGC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-07	1.3E+01	1.3E-07	1.3E+01
HCDHC	3	3.7E-07	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.7E-07	1.3E+01	7.4E-07	1.3E+01	N/A	--
HCCGC	3	8.9E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-07	1.3E+01	N/A	--
HCCHC	3	8.9E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.9E-08	1.3E+01	1.8E-07	1.3E+01	N/A	--
HCMVC	3	7.1E-07	1.3E+01	N/A	--	N/A	--	N/A	--	7.1E-07	1.3E+01	N/A	--	1.4E-06	1.3E+01	7.1E-07	1.3E+01
HCFGC	3	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01
HCFHC	3	5.0E-08	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	5.0E-08	1.3E+01	1.0E-07	1.3E+01	N/A	--
HCFVC	3	5.0E-08	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01
HCQGC	3	5.0E-08	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01
HCQVC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01
HCRGC	3	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	5.3E-06	1.3E+01	2.6E-06	1.3E+01
HCRVC	3	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	5.3E-06	1.3E+01	2.6E-06	1.3E+01

File: HDLNAT.WK1, Page 2 Date 18-Aug-87

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

Accident Frequencies and Range Factors

SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCSVC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.1E-07	1.3E+01	1.5E-07	1.3E+01
HCBGC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	1.7E-09	1.3E+01
HCDHC	4	8.0E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.0E-10	1.3E+01	1.6E-09	1.3E+01	N/A	--
HCCGC	4	2.0E-11	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-11	1.3E+01	N/A	--
HCCHC	4	2.0E-11	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-11	1.3E+01	3.9E-11	1.3E+01	N/A	--
HCKGC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	1.3E+01	N/A	--
HCKHC	4	7.2E-09	1.3E+01	6.7E-09	1.3E+01	N/A	--	N/A	--	6.7E-09	1.3E+01	N/A	--	1.4E-08	1.3E+01	7.2E-09	1.3E+01
HCKVC	4	N/A	--	N/A	--	N/A	--	7.2E-09	1.3E+01	N/A	--	N/A	--	1.4E-08	1.3E+01	N/A	--
HCMVC	4	6.9E-10	1.3E+01	N/A	--	N/A	--	N/A	--	6.9E-10	1.3E+01	N/A	--	1.4E-09	1.3E+01	6.9E-10	1.3E+01
HCPGC	4	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		0.0E+00	--
HCFHC	4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00		N/A	--
HCFVC	4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00		0.0E+00	--
HCQGC	4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00		0.0E+00	--
HCQVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		0.0E+00	--
HCRGC	4	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	6.2E-09	1.3E+01	3.1E-09	1.3E+01
HCRVC	4	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	6.2E-09	1.3E+01	3.1E-09	1.3E+01
HCSVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-08	1.3E+01	2.7E-08	1.3E+01
HCBGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.3E-09	1.3E+01	N/A	--
HCDHS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.3E-09	1.3E+01	N/A	--
HCCGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HCCHS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HCKGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--
HCKHS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--
HCKVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--
HCMVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--
HCFGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--
HCFHS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--
HCFVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--
HCQGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--

File: HDLNAT.WK1, Page 3 Date 18-Aug-87

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

Accident Frequencies and Range Factors

SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCQVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--
HCRGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.9E-09	1.3E+01	N/A	--
HCRVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.9E-09	1.3E+01	N/A	--
HCSVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-07	1.3E+01	N/A	--
HCBGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.2E-11	3.1E+01	N/A	--
HCDHF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--
HCCGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCCHF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCKGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--
HCKHF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--
HCKVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--
HCMVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-10	3.1E+01	N/A	--
HCFGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCPHF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCPVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCQGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCQVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCRGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	3.1E+01	N/A	--
HCRVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	3.1E+01	N/A	--
HCSVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-09	3.1E+01	N/A	--
HCBGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.7E-09	1.3E+01	N/A	--
HCDHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-08	1.3E+01	N/A	--
HCCGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCCHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCKGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--
HCKHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--
HCKVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--
HCMVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	1.3E+01	N/A	--
HCFGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--

File: HOLNAT.WK1, Page 4 Date 18-Aug-87

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

Accident Frequencies and Range Factors

SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCFHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCFVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCQGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCQVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCRGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-09	1.3E+01	N/A	--
HCRVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-09	1.3E+01	N/A	--
HCSVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-07	1.3E+01	N/A	--
HCBGS	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-08	1.3E+01	2.3E-08	1.3E+01
HCDHS	8	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	1.2E-08	1.3E+01	N/A	--
HCCGS	8	8.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.8E-09	1.3E+01	N/A	--
HCCHS	8	8.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.8E-09	1.3E+01	8.8E-09	1.3E+01	N/A	--
HCKGS	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--
HCKHS	8	2.2E-08	1.3E+01	2.2E-08	1.3E+01	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--	2.2E-08	1.3E+01	2.2E-08	1.3E+01
HCKVS	8	N/A	--	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--
HCMVS	8	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	1.2E-08	1.3E+01	1.2E-08	1.3E+01
HCPGS	8	1.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01
HCFHS	8	1.0E-08	1.3E+01	N/A	--	1.0E-08	1.3E+01	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01	N/A	--
HCFVS	8	1.0E-08	1.3E+01	N/A	--	1.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01
HCQGS	8	1.0E-08	1.3E+01	N/A	--	1.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01
HCQVS	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01
HCRGS	8	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	1.3E-08	1.3E+01
HCRVS	8	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	1.3E-08	1.3E+01
HCSVS	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.5E-09	1.3E+01	8.5E-09	1.3E+01
HCBGF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-10	3.1E+01	8.6E-10	3.1E+01
HCDHF	9	5.4E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-10	3.1E+01	5.4E-10	3.1E+01	N/A	--
HCCGF	9	2.6E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-10	3.1E+01	N/A	--
HCCHF	9	2.6E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-10	3.1E+01	2.6E-10	3.1E+01	N/A	--
HCKGF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--
HCKHF	9	6.9E-10	3.1E+01	6.9E-10	3.1E+01	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--	6.9E-10	3.1E+01	6.9E-10	3.1E+01

File: HDLNAT.WK1, Page 5 Date 18-Aug-87

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

Accident Frequencies and Range Factors

SCEN-ARIO	OF.	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCKVF		9	N/A	--	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--
HCMVF		9	5.3E-10	3.1E+01	N/A	--	N/A	--	N/A	--	5.3E-10	3.1E+01	N/A	--	5.3E-10	3.1E+01	5.3E-10	3.1E+01
HCFGF		9	1.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01
HCFHF		9	1.2E-10	3.1E+01	N/A	--	1.2E-10	3.1E+01	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01	N/A	--
HCFVF		9	1.2E-10	3.1E+01	N/A	--	1.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01
HCOGF		9	1.2E-10	3.1E+01	N/A	--	1.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01
HCQVF		9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01
HCRGF		9	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	5.6E-10	3.1E+01
HCRVF		9	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	5.6E-10	3.1E+01
HCSVF		9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-10	3.1E+01	2.7E-10	3.1E+01
HCBGS		10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-08	1.3E+01	1.1E-08	1.3E+01
HCDHS		10	6.9E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	6.9E-09	1.3E+01	6.9E-09	1.3E+01	N/A	--
HCCGS		10	3.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	N/A	--
HCCHS		10	3.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	3.4E-09	1.3E+01	N/A	--
HCKGS		10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.8E-09	1.3E+01	N/A	--
HCKHS		10	8.8E-09	1.3E+01	8.8E-09	1.3E+01	N/A	--	N/A	--	8.8E-09	1.3E+01	N/A	--	8.8E-09	1.3E+01	8.8E-09	1.3E+01
HCKVS		10	N/A	--	N/A	--	N/A	--	8.8E-09	1.3E+01	N/A	--	N/A	--	8.8E-09	1.3E+01	N/A	--
HCMVS		10	6.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	6.8E-09	1.3E+01	N/A	--	6.8E-09	1.3E+01	6.8E-09	1.3E+01
HCFGS		10	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01
HCFHS		10	1.6E-09	1.3E+01	N/A	--	1.6E-09	1.3E+01	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01	N/A	--
HCFVS		10	1.6E-09	1.3E+01	N/A	--	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01
HCOGS		10	1.6E-09	1.3E+01	N/A	--	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01
HCQVS		10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01
HCRGS		10	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	7.2E-09	1.3E+01
HCRVS		10	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	7.2E-09	1.3E+01
HCSVS		10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-09	1.3E+01	3.5E-09	1.3E+01
HCDHC		11	2.9E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-09	2.6E+01	5.8E-09	2.6E+01	N/A	--
HCCGC		11	1.4E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-09	2.6E+01	N/A	--
HCCHC		11	1.4E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-09	2.6E+01	2.9E-09	2.6E+01	N/A	--

File: HDLNAT.WK1, Page 6 Date 18-Aug-87

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

Accident Frequencies and Range Factors

SCEN-ARIO	OP.	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCMVC		11	2.2E-09	2.6E+01	N/A	--	N/A	--	N/A	--	2.2E-09	2.6E+01	N/A	--	4.3E-09	2.6E+01	2.2E-09	2.6E+01
HCPGC		11	4.8E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-10	2.6E+01	4.8E-10	2.6E+01
HCPHC		11	4.8E-10	2.6E+01	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	4.8E-10	2.6E+01	9.6E-10	2.6E+01	N/A	--
HCPVC		11	4.8E-10	2.6E+01	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	N/A	--	9.6E-10	2.6E+01	4.8E-10	2.6E+01
HCQGC		11	3.6E-10	2.6E+01	N/A	--	3.6E-10	2.6E+01	N/A	--	N/A	--	N/A	--	7.2E-10	2.6E+01	3.6E-10	2.6E+01
HCQVC		11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	2.6E+01	3.6E-10	2.6E+01
HCRGC		11	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	1.8E-09	2.6E+01	9.0E-10	2.6E+01
HCRVC		11	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	1.8E-09	2.6E+01	9.0E-10	2.6E+01
HCDHC		12	2.1E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	2.6E+01	4.1E-10	2.6E+01	N/A	--
HCCGC		12	1.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	2.6E+01	N/A	--
HCCHC		12	1.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	2.6E+01	2.1E-10	2.6E+01	N/A	--
HCMVC		12	1.5E-10	2.6E+01	N/A	--	N/A	--	N/A	--	1.5E-10	2.6E+01	N/A	--	3.1E-10	2.6E+01	1.5E-10	2.6E+01
HCPGC		12	3.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.9E-11	2.6E+01	3.4E-11	2.6E+01
HCPHC		12	3.4E-11	2.6E+01	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	3.4E-11	2.6E+01	6.9E-11	2.6E+01	N/A	--
HCPVC		12	3.4E-11	2.6E+01	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.9E-11	2.6E+01	3.4E-11	2.6E+01
HCQGC		12	2.6E-11	2.6E+01	N/A	--	2.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	5.2E-11	2.6E+01	2.6E-11	2.6E+01
HCQVC		12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-11	2.6E+01	2.6E-11	2.6E+01
HCRGC		12	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	1.3E-10	2.6E+01	6.5E-11	2.6E+01
HCRVC		12	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	1.3E-10	2.6E+01	6.5E-11	2.6E+01
HCBGC		17	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E-13	2.6E+01	6.0E-13	2.6E+01
HCRGC		17	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	6.0E-13	2.6E+01
HCRVC		17	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	6.0E-13	2.6E+01
HCBGC		18	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-12	2.6E+01	1.2E-12	2.6E+01
HCRGC		18	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	1.2E-12	2.6E+01
HCRVC		18	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	1.2E-12	2.6E+01
HCBGC		19	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-15	3.1E+01	2.6E-15	3.1E+01
HCRGC		19	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	2.6E-14	3.1E+01
HCRVC		19	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	2.6E-14	3.1E+01
HCBGC		21	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-18	3.1E+01	3.4E-18	3.1E+01

File: HDLNAT.WK1, Page 7 Date 18-Aug-87

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

Accident Frequencies and Range Factors

SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCRGC	21	3.1E-18	3.1E+01	N/A	--	3.1E-18	3.1E+01	N/A	--	3.1E-18	3.1E+01	N/A	--	3.1E-18	3.1E+01	3.1E-18	3.1E+01
HCRVC	21	3.1E-18	3.1E+01	N/A	--	3.1E-18	3.1E+01	N/A	--	3.1E-18	3.1E+01	N/A	--	3.1E-18	3.1E+01	3.1E-18	3.1E+01
HCDHC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.7E-11	2.6E+01	N/A	--
HCCGC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--
HCCHC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--
HCMVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--
HCFGC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--
HCFHC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--
HCFVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--
HCQGC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--
HCQVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--
HCRGC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-11	2.6E+01	N/A	--
HCRVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-11	2.6E+01	N/A	--
HCDHC	23	2.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-11	2.6E+01	2.3E-11	2.6E+01	N/A	--
HCCGC	23	3.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-11	2.6E+01	N/A	--
HCCHC	23	3.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-11	2.6E+01	3.5E-11	2.6E+01	N/A	--
HCMVC	23	1.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.3E-11	2.6E+01	N/A	--	1.3E-11	2.6E+01	1.3E-11	2.6E+01
HCFGC	23	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01
HCFHC	23	1.4E-11	2.6E+01	N/A	--	1.4E-11	2.6E+01	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01	N/A	--
HCFVC	23	1.4E-11	2.6E+01	N/A	--	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01
HCQGC	23	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01
HCQVC	23	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01
HCRGC	23	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01
HCRVC	23	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01
HCDHC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.2E-11	2.6E+01	N/A	--
HCCGC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	2.6E+01	N/A	--
HCCHC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	2.6E+01	N/A	--
HCMVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.6E-11	2.6E+01	N/A	--
HCFGC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--

File: HDLNAT.WK1, Page 8 Date 18-Aug-87

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

Accident Frequencies and Range Factors

SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCFHC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--
HCPVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--
HCQGC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--
HCQVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--
HCRGC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-11	2.6E+01	N/A	--
HCRVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-11	2.6E+01	N/A	--
HCDHC	25	1.7E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	2.6E+01	1.7E-11	2.6E+01	N/A	--
HCCGC	25	2.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.5E-11	2.6E+01	N/A	--
HCCHC	25	2.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.5E-11	2.6E+01	2.5E-11	2.6E+01	N/A	--
HCMVC	25	9.3E-12	2.6E+01	N/A	--	N/A	--	N/A	--	9.3E-12	2.6E+01	N/A	--	9.3E-12	2.6E+01	9.3E-12	2.6E+01
HCPGC	25	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01
HCFHC	25	1.0E-11	2.6E+01	N/A	--	1.0E-11	2.6E+01	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01	N/A	--
HCPVC	25	1.0E-11	2.6E+01	N/A	--	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01
HCQGC	25	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01
HCQVC	25	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01
HCRGC	25	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01
HCRVC	25	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01
HCBGF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCDHC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCCGC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCCHC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	-
HCKGF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HC.HF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCKVF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCMVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCFGC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCFHC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCFVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCQGC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--

File: HDLNAT.WK1, Page 9 Date 21-Aug-87

TABLE 6-4 (Continued)

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

Accident Frequencies and Range Factors

SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HCQVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCFSC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCRVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCSVF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCBGF	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCDHC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--
HCCGC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCCHC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--
HCKGF	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCKHF	27	0.0E+00	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--
HCNVF	27	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HCMVC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--
HCFSC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCFHC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--
HCFVC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCQGC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCQVC	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCRGC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--
HCRVC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--
HCSVF	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
HCRGC	29	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	9.0E-09	2.6E+01
HCRVC	29	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	9.0E-09	2.6E+01
HCRGC	30	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	1.8E-08	2.6E+01
HCRVC	30	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	1.8E-08	2.6E+01
HCRGC	31	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	1.3E-10	2.6E+01
HCRVC	31	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	1.3E-10	2.6E+01
HCBGS	32	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-03	1.0E+01	1.0E-03	1.0E+01
HCRGS	32	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	1.0E-03	1.0E+01
HCRVS	32	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	1.0E-03	1.0E+01

File: HFNAT.WK1 Page 1 Date 20 Aug-87

TABLE 6-4 (Continued)

NATIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HFBGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E-09	1.3E+01	N/A	--
HFDHS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E-09	1.3E+01	N/A	--
HFCGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-10	1.3E+01	N/A	--
HFCHS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-10	1.3E+01	N/A	--
HFKGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--
HFKHS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--
HFKVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--
HFMVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.8E-09	1.3E+01	N/A	--
HFFGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HFFHS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HFFVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HFQGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HFQVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--
HFRGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	1.3E+01	N/A	--
HFRVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	1.3E+01	N/A	--
HFSVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-06	1.3E+01	N/A	--
HFBGC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-16	3.1E+01	N/A	--
HFDHC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCGC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCHC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/	--	N/A	--	0.0E+00		N/A	--
HFKGC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.4E-16	3.1E+01	N/A	--
HFKHC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.4E-16	3.1E+01	N/A	--
HFKVC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.4E-16	3.1E+01	N/A	--
HFMVC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-17	3.1E+01	N/A	--
HFPGC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFFHC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPVC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQGS	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQVS	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--

TABLE 6-4 (Continued)

NATIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HFRGC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-16	3.1E+01	N/A	--
HFRVC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-16	3.1E+01	N/A	--
HFSVC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.5E-15	3.1E+01	N/A	--
HFBGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	3.1E+01	N/A	--
HFDHF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.4E-11	3.1E+01	N/A	--
HFCGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCHF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	3.1E+01	N/A	--
HFKHF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	3.1E+01	N/A	--
HFKVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	3.1E+01	N/A	--
HFMVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-10	3.1E+01	N/A	--
HFPGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPHF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFRGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.1E-11	3.1E+01	N/A	--
HFRVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.1E-11	3.1E+01	N/A	--
HFSVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-09	3.1E+01	N/A	--
HFSVS	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-07	1.3E+01	N/A	--
HFBGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFDHC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCGC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCHC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKHF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKVF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFMVC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPGC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--

File: HFNAI.WK1   Page 3   Date 20-Aug-87

TABLE 6-4 (Continued)

NATIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HFPHC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPVC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQGC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQVC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFRGC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFRVC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFSVF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFBGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.3E-10	1.3E+01	N/A	--
HFDHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.5E-09	1.3E+01	N/A	--
HFCGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-09	1.3E+01	N/A	--
HFKHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-09	1.3E+01	N/A	--
HFKVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-09	1.3E+01	N/A	--
HFMVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-09	1.3E+01	N/A	--
HFPGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFPVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFRGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	1.3E+01	N/A	--
HFRVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	1.3E+01	N/A	--
HFSVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	1.3E+01	N/A	--
HFBGC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.3E-18	3.1E+01	N/A	--
HFDHC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.3E-18	3.1E+01	N/A	--
HFCGC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E-19	3.1E+01	N/A	--
HFCHC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E-19	3.1E+01	N/A	--
HFKGC	8	N/A	--	N/A	--	N/A	-	[illegible]	--	N/A	--	N/A	--	1.1E-17	3.1E+01	N/A	--
HFKHC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-17	3.1E+01	N/A	--

File: HFNAT.WK1 Page 4 Date 20-Aug-87

TABLE 6-4 (Continued)

NATIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HFKVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-17	3.1E+01	N/A	--
HFMVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-18	3.1E+01	N/A	--
HFFSC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--
HFFHC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--
HFFVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--
HFQGC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--
HFQVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--
HFRGC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-18	3.1E+01	N/A	--
HFRVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-18	3.1E+01	N/A	--
HFSVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-15	3.1E+01	N/A	--
HFSVC	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-16	3.1E+01	N/A	--
HFBGC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-19	3.1E+01	N/A	--
HFDHC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-18	3.1E+01	N/A	--
HFCGC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFCHC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFKGC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-18	3.1E+01	N/A	--
HFKHC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-18	3.1E+01	N/A	--
HFKVC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-18	3.1E+01	N/A	--
HFMVC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-18	3.1E+01	N/A	--
HFFGC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFFHC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFFVC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQGC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFQVC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--
HFRGC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-18	3.1E+01	N/A	--
HFRVC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-18	3.1E+01	N/A	--
HFSVC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-17	3.1E+01	N/A	--
HFDHC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.8E-11	2.6E+01	N/A	--
HFCGC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-11	2.6E+01	N/A	--

File: HFNAT.WK1 Page 5 Date 20-Aug-87

TABLE 6-4 (Continued)

NATIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HFCHC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-11	2.6E+01	N/A	--
HFMVC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--
HFFGC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-12	2.6E+01	N/A	--
HFFHC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-12	2.6E+01	N/A	--
HFFVC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-12	2.6E+01	N/A	--
HFQGC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	N/A	--
HFQVC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	N/A	--
HFRGC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-11	2.6E+01	N/A	--
HFRVC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-11	2.6E+01	N/A	--
HFDHC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFCGC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFCHC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFMVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFFGC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFFHC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFFVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFQGC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFQVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFRGC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFFVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--
HFDHC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-11	2.6E+01	N/A	--
HFCGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-11	2.6E+01	N/A	--
HFCHC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-11	2.6E+01	N/A	--
HFMVC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
HFFGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-11	2.6E+01	N/A	--
HFFHC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-11	2.6E+01	N/A	--
HFPVC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-11	2.6E+01	N/A	--
HFQGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-12	2.6E+01	N/A	--
HFQVC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-12	2.6E+01	N/A	--

File: HFNAT.WK1 Page 6 Date 20-Aug-87

TABLE 6-4 (Continued)

NATIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HFRGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--
HFRVC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--
HFDHC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-14	2.6E+01	N/A	--
HFCGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.6E-15	2.6E+01	N/A	--
HFCHC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.6E-15	2.6E+01	N/A	--
HFMVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.9E-15	2.6E+01	N/A	--
HFFGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-15	2.6E+01	N/A	--
HFFHC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-15	2.6E+01	N/A	--
HFFVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-15	2.6E+01	N/A	--
HFQGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-15	2.6E+01	N/A	--
HFQVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-15	2.6E+01	N/A	--
HFRGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-15	2.6E+01	N/A	--
HFRVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-15	2.6E+01	N/A	--

6.4. UNCERTAINTY ANALYSIS FOR HANDLING ASSOCIATED WITH RAIL TRANSPORT

The values shown in the range factor column in Table 6-4 represent the ratios of the 95th percentile values to the median values. The range factors vary from 13 to 31. The accident sequence frequencies with the largest uncertainty involve (1) forklift collision accidents with fire (H06, HF3) and (2) munition drop accidents inside the MDB. For the latter, the additional failure of the ventilation system for an agent release to the atmosphere to occur is a contributor to the overall uncertainty in the results.

The assignment of error factors to the accident frequency or event probability data was based entirely on engineering judgment. For the handling accidents, the initiating event itself (drop, collision, fork-lift tine puncture) is assigned an error factor of 10. The puncture probability given a drop or collision is assigned an error factor of 3. An error factor of 10 is assigned to the following events: (1) probability of fire given a collision; (2) ventilation system failure; and (3) low-impact detonation of burstered munitions. The error factors for specific events identified in the accident analysis are shown in Tables 6-2 and 6-3.

6.5. ANALYSIS FOR AIR TRANSPORT

The generic handling operations at both the sending and receiving sites are identical to the operations described above for the rail transportation option for the ton containers, the projectiles, and the rockets except for the operations occurring between the holding area and the air strip which are specific to the air transportation option. The list of accident sequences identified for the rail transportation option was used and applied to the air transportation option. Onsite handling operations (HA) and facility-related handling operations (HF) are identified. For the air transportation option only the results which pertain to ton containers, projectiles, and rockets apply.

Table 6-5 presents the initiating event frequencies for the accident scenarios. These frequencies correspond, in terms of events per operation, closely to those used for the rail option handling. Table 6-6 presents the conditional event probabilities for the subsequent events along the sequence pathways.

The sequence frequencies and uncertainty analysis results are presented in Table 6-7 for the air transport option.

TABLE 6-5
INITIATING EVENTS FREQUENCIES
(HANDLING ASSOCIATED WITH AIR TRANSPORT)

INITIATING EVENTS FREQUENCIES

	INITIATING EVENT	FREQUENCY EVENTS/OP	ERROR FACTOR	REFERENCE (NOTES)	APPLICABLE SCENARIOS
		(Col.H)	(Col.I)		
HE10	Pallet or single item dropped during handling of non-leaking munition outside the MDB (1)				HA1,HA5,HA8,HA11,HA22,H HF1,HF11
HE10A	Items lifted with tines	3.0E-05	10.0	6,7	
HE10B	Items lifted with lifting beams	3.0E-06	10.0	8	
HE15	Pallet or container dropped during handling of non-leaking munition inside the MDB (2)				HF8,HF13
HE15A	Items lifted with tines	1.5E-04	10.0	7	
HE15B	Items lifted with lifting beams	1.5E-05	10.0	8	
HE20	Pallet or container dropped during handling of leaking munition (3)				HA17,HA29
HE20A	Items lifted with tines	3.0E-04	10.0	7	
HE20B	Items lifted with lifting beams	3.0E-05	10.0	8	
HE25	Single munition dropped inside the MDB (4)	3.0E-04	10.0		HF2,HF12
HE35	Single leaking munition dropped (3)	6.0E-04	10.0		HA18,HA30
HE40	Forklift tine accident involving munition handling outside the MDB (1)	1.0E-05	10.0		HA3,HF4
HE45	Forklift tine accident involving munition handling inside the MDB (2)	5.0E-05	10.0		HF9
HE50	Forklift tine accident involving handling of leaking munition (3)	1.0E-04	10.0		HA19
HE55	Vehicle collision accident	4.3E-06	10.0	GA derive data, see details i Appendix	HA2,HA4,HA6,HA7,HA9,HA10 HA12,HA21,HA24,HA25,HA26 HA27,HA31,HF3,HF5,HF7, HF10,HF14
HE65	Failure to detect a leak in the	1.0E-03	10.0		HA32

TABLE 6-5 (Continued)

transportation container

NOTES:

(1) Handled by forklift or other handling equipment; operators wearing street clothes with mask slung

(2) Handled by forklift; operators wearing mask, gloves, and boots; excluding ton container

(3) Operators in level A clothing

(4) Handled singly by hand; operators wearing mask, gloves and boots.

(6) 3.0e-5 = 3*10-5

(7) For all items lifted with tines (spray tanks in overpacks and bare munitions)

(8) Items lifted by a lifting beam or by a cargo handling equipment

TABLE 6-6
CONDITIONAL EVENTS PROBABILITIES (AIR TRANSPORT)

	EVENT SEQUENCE	EVENT PROBABILITY	ERROR FACTOR	REFERENCE	APPLICABLE SCENARIO
HE100	Palletized or single munition punctured given a drop outside the MDB (Drop ht = 6ft.)				HA1
HE100K	Ton Container	3.34E-03	3.0		
HE100P	155-mm Projectile	0.00E+00			
HE100Q	8-in Projectile	0.00E+00			
HE100R	Rocket	7.95E-04	3.0		
HE110	Offsite container and munition punctured given a drop of the offsite container (4ft drop)				HA8,HF1
HE110K	Ton Container	1.83E-03	3.0		
HE110P	155-mm Projectile	8.40E-04	3.0		
HE110Q	8-in Projectile	8.40E-04	3.0		
HE110R	Rocket	1.06E-03	3.0		
HE120	Container and munition punctured given drop of the offsite container (2ft drop)				HA9,HA10
HE120K	Ton Container	1.10E-03	3.0		
HE120P	155-mm Projectile	2.00E-04	3.0		
HE120Q	8-in Projectile	2.00E-04	3.0		
HE120R	Rocket	9.00E-04	3.0		
HE140	Palletized or single munition punctured given a drop resulting from collision (Drop ht = 2ft.)				HA2,HA4,HA21
HE140K	Ton Container	1.68E-03	3.0		
HE140P	155-mm Projectile	0.00E+00			
HE140Q	8-in Projectile	0.00E+00			
HE140R	Rocket	7.16E-04	3.0		
HE150	Palletized munition in onsite container puncture given a drop of container (Drop ht = 4ft., also applies to handling in UPA)				HF8, HA5

TABLE 6-6 (Continued)

HE150K	Ton Container	7.20E-04	3.0		
HE150P	155-mm Projectile	6.00E-05	3.0		
HE150Q	8-in Projectile	6.00E-05	3.0		
HE150R	Rocket	2.70E-04	3.0		
HE160	Palletized or single munition in onsite container punctured given drop resulting from collision (2ft drop)				HH6,HH7
HE160K	Ton Container	3.30E-04	3.0		
HE160P	155-mm Projectile	0.00E+00			
HE160Q	8-in Projectile	0.00E+00			
HE160R	Rocket	2.60E-04	3.0		
HE250	Single bare munition punctured given drop in UPA (Drop ht = 4ft.)				HF2
HE250K	Ton Container	2.80E-03	3.0		
HE250P	155-mm Projectile	0.00E+00			
HE250Q	8-in Projectile	0.00E+00			
HE250R	Rocket	5.93E-04	3.0		
HE400	Munition punctured by forklift tines				HH3,HH19
HE400P	155-mm Projectile	5.00E-03	3.0		
HE400Q	8-in Projectile	5.00E-03	3.0		
HE400R	Rocket	2.63E-01	3.0		
HE550	Fire results from vehicle collision	7.25E-02	10.0	See App F	HH2,HH6,HH9, HH26,HH27,HF3,HF5
HE555	Collision does not cause fire	9.27E-01	none	See App F	HH7,HH10, HF7
HE560	Fire contained				HH2,HH5,HH9,HF3
HE560A	4 min - Burstered munitions	5.00E-01	none		
HE560B	30 min - Non burstered munitions	1.00E+00	none		
HE560C	/15 min - On/Offsite container	1.00E+00	none		

TABLE 6-6 (Continued)

HE570	Fire not contained			HA26,HA27,HF5
HE570A	4 min - Burstered munitions	5.00E-01	none	
HE570B	30 min - Non burstered munitions	0.00E+00	none	
HE570C	>15 min - On/Offsite container	0.00E+00	none	
HE590	Munition in on/offsite container detonates or ruptures given prolonged fire (>15 min)	1.00E+00	none	HA26,HA27,HF5
HE600	Munition detonates given drop (6ft) or collision (per munition)	9.50E-09		HA11,HA12 HA29,HA30,HA31 (R)
HE600P	155-mm Projectile (8)	7.60E-08	10.0	
HE600Q	8-in Projectile (6)	5.70E-08	10.0	
HE600R	Rocket (15)	1.43E-07	10.0	
HE620	Single bare munition detonates given 4 ft drop (in UPA)	3.20E-10	10.0	HF12
HE700	Munition in onsite container detonates given drop (per munition)	3.20E-11		HA22,HA24, HF11,HF13,HF14
HE700P	155-mm Projectile (8)	2.56E-10	10.0	
HE700Q	8-in Projectile (6)	1.92E-10	10.0	
HE700R	Rocket (15)	4.80E-10	10.0	
HE710	Munition in offsite container detonates given drop (per munition)	3.20E-12		HA23,HA25
HE710P	155-mm Projectile (8)	3.84E-10	10.0	
HE710Q	8-in Projectile (6)	1.92E-10	10.0	
HE710R	Rocket (15)	1.92E-10	10.0	
HE800	MDB Ventilation System Failure	1.00E-09	10.0	HA17,HA18,HA19,HA21 HF2, HF8,HF9,HF10

DATE18-Aug-87 PAGE1

TABLE 6-7
HANDLING ACCIDENT FREQUENCIES - COLLOCATION PROCESSING OPTION (AIR TRANSPORT)

HANDLING ACCIDENTS - COLLOCATION PROCESSING OPTION (AIR TRANSPORT) (PER CONTAINER OR PALLET)

Accident Frequencies and Range Factors

SCEN-ARIO	NO	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HAKHS	1	N/A	--	2.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	4.0E-08	1.3E+01	N/A	--
HAFHC	1	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAFVC	1	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAQGC	1	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HARGC	1	N/A	--	N/A	--	4.8E-08	1.3E+01	N/A	--	N/A	--	N/A	--	9.5E-08	1.3E+01	N/A	--
HARVC	1	N/A	--	N/A	--	4.8E-08	1.3E+01	N/A	--	N/A	--	N/A	--	9.5E-08	1.3E+01	N/A	--
HAKHF	2	N/A	--	5.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
HAFHC	3	N/A	--	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	N/A	--
HAFVC	3	N/A	--	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	N/A	--
HAQGC	3	N/A	--	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	N/A	--
HARGC	3	N/A	--	N/A	--	2.6E-06	1.3E+01	N/A	--	N/A	--	N/A	--	5.3E-06	1.3E+01	N/A	--
HARVC	3	N/A	--	N/A	--	2.6E-06	1.3E+01	N/A	--	N/A	--	N/A	--	5.3E-06	1.3E+01	N/A	--
HAKHS	4	N/A	--	6.7E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	1.3E+01	N/A	--
HAFHC	4	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAFVC	4	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAQGC	4	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HARGC	4	N/A	--	N/A	--	3.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	6.2E-09	1.3E+01	N/A	--
HARVC	4	N/A	--	N/A	--	3.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	6.2E-09	1.3E+01	N/A	--
HAKHS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--
HAFHS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	--	N/A	--
HAFVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	--	N/A	--
HAQGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	--	N/A	--
HARGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.9E-09	1.3E+01	N/A	--
HARVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.9E-09	1.3E+01	N/A	--
HAKHF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--
HAFHF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAFVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAQGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HARGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	3.1E+01	N/A	--

TABLE 6-7 (Continued)

HANDLING ACCIDENTS - COLLOCATION PROCESSING OPTION (AIR TRANSPORT) (PER CONTAINER OR PALLET)

Accident Frequencies and Range Factors

SCEN-ARIO	NO	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	FUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HARVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	3.1E+01	N/A	--
HAKHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-09	1.3E+01	N/A	--
HAPHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAPVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAQGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HARGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	1.3E+01	N/A	--
HARVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	1.3E+01	N/A	--
HAKHS	8	N/A	--	3.3E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-08	1.3E+01	N/A	--
HAPHS	8	N/A	--	N/A	--	1.5E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.5E-08	1.3E+01	N/A	--
HAPVS	8	N/A	--	N/A	--	1.5E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.5E-08	1.3E+01	N/A	--
HAQGS	8	N/A	--	N/A	--	1.5E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.5E-08	1.3E+01	N/A	--
HARGS	8	N/A	--	N/A	--	1.9E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.9E-08	1.3E+01	N/A	--
HARVS	8	N/A	--	N/A	--	1.9E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.9E-08	1.3E+01	N/A	--
HAKHF	9	N/A	--	1.0E-09	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-09	3.1E+01	N/A	--
HAPHF	9	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--
HAPVF	9	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--
HAQGF	9	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--
HARGF	9	N/A	--	N/A	--	8.4E-10	3.1E+01	N/A	--	N/A	--	N/A	--	8.4E-10	3.1E+01	N/A	--
HARVF	9	N/A	--	N/A	--	8.4E-10	3.1E+01	N/A	--	N/A	--	N/A	--	8.4E-10	3.1E+01	N/A	--
HAKHS	10	N/A	--	1.3E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--
HAPHS	10	N/A	--	N/A	--	2.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	2.4E-09	1.3E+01	N/A	--
HAPVS	10	N/A	--	N/A	--	2.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	2.4E-09	1.3E+01	N/A	--
HAQGS	10	N/A	--	N/A	--	2.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	2.4E-09	1.3E+01	N/A	--
HARGS	10	N/A	--	N/A	--	1.1E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.1E-08	1.3E+01	N/A	--
HARVS	10	N/A	--	N/A	--	1.1E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.1E-08	1.3E+01	N/A	--
HAPHC	11	N/A	--	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	N/A	--	9.6E-10	2.6E+01	N/A	--
HAPVC	11	N/A	--	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	N/A	--	9.6E-10	2.6E+01	N/A	--
HAQGC	11	N/A	--	N/A	--	3.6E-10	2.6E+01	N/A	--	N/A	--	N/A	--	7.2E-10	2.6E+01	N/A	--
HARGC	11	N/A	--	N/A	--	9.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	1.8E-09	2.6E+01	N/A	--

DATE18-Aug-87 PAGE3

TABLE 6-7 (Continued)

HANDLING ACCIDENTS - COLLOCATION PROCESSING OPTION (AIR TRANSPORT) (PER CONTAINER OR PALLET)

Accident Frequencies and Range Factors

SCEN-ARIO	NO	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HARVC	11	N/A	--	N/A	--	9.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	1.8E-09	2.6E+01	N/A	--
HAFHC	12	N/A	--	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.9E-11	2.6E+01	N/A	--
HAFVC	12	N/A	--	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.9E-11	2.6E+01	N/A	--
HAQGC	12	N/A	--	N/A	--	2.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	5.2E-11	2.6E+01	N/A	--
HARGC	12	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.3E-10	2.6E+01	N/A	--
HARVC	12	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.3E-10	2.6E+01	N/A	--
HARGC	17	N/A	--	N/A	--	6.0E-13	2.6E+01	N/A	--	N/A	--	N/A	--	6.0E-13	2.6E+01	N/A	--
HARVC	17	N/A	--	N/A	--	6.0E-13	2.6E+01	N/A	--	N/A	--	N/A	--	6.0E-13	2.6E+01	N/A	--
HARGC	18	N/A	--	N/A	--	1.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	1.2E-12	2.6E+01	N/A	--
HARVC	18	N/A	--	N/A	--	1.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	1.2E-12	2.6E+01	N/A	--
HARGC	19	N/A	--	N/A	--	2.6E-14	3.1E+01	N/A	--	N/A	--	N/A	--	2.6E-14	3.1E+01	N/A	--
HARVC	19	N/A	--	N/A	--	2.6E-14	3.1E+01	N/A	--	N/A	--	N/A	--	2.6E-14	3.1E+01	N/A	--
HARGC	21	N/A	--	N/A	--	3.1E-18	3.1E+01	N/A	--	N/A	--	N/A	--	3.1E-18	3.1E+01	N/A	--
HARVC	21	N/A	--	N/A	--	3.1E-18	3.1E+01	N/A	--	N/A	--	N/A	--	3.1E-18	3.1E+01	N/A	--
HAFHC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--
HAFVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--
HAQGC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--
HARGC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-11	2.6E+01	N/A	--
HAFVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-11	2.6E+01	N/A	--
HAFHC	23	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--
HAFVC	23	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--
HAQGC	23	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--
HARGC	23	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--
HARVC	23	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--
HAFHC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--
HAFVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--
HAQGC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--
HARGC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-11	2.6E+01	N/A	--
HARVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-11	2.6E+01	N/A	--

DATE18-Aug-87 PAGE4

TABLE 6-7 (Continued)

HANDLING ACCIDENTS - COLLOCATION PROCESSING OPTION (AIR TRANSPORT) (PER CONTAINER OR PALLET)

Accident Frequencies and Range Factors

SCEN-ARIO	NO	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
HAPHC	25	N/A	--	N/A	--	1.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.5E-11	2.6E+01	N/A	--
HAPVC	25	N/A	--	N/A	--	1.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.5E-11	2.6E+01	N/A	--
HAQGC	25	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--
HARGC	25	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--
HARVC	25	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--
HAPHF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAPHC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAPVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAQGC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HARGC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HARVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAPHF	27	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAPHC	27	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAPVC	27	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HAQGC	27	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HARGC	27	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HARVC	27	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
HARGC	29	N/A	--	N/A	--	9.0E-09	2.6E+01	N/A	--	N/A	--	N/A	--	9.0E-09	2.6E+01	N/A	--
HARVC	29	N/A	--	N/A	--	9.0E-09	2.6E+01	N/A	--	N/A	--	N/A	--	9.0E-09	2.6E+01	N/A	--
HARGC	30	N/A	--	N/A	--	1.8E-08	2.6E+01	N/A	--	N/A	--	N/A	--	1.8E-08	2.6E+01	N/A	--
HARVC	30	N/A	--	N/A	--	1.8E-08	2.6E+01	N/A	--	N/A	--	N/A	--	1.8E-08	2.6E+01	N/A	--
HARGC	31	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--
HARVC	31	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--
HARGS	32	N/A	--	N/A	--	1.0E-03	1.0E+01	N/A	--	N/A	--	N/A	--	1.0E-03	1.0E+01	N/A	--
HARVS	32	N/A	--	N/A	--	1.0E-03	1.0E+01	N/A	--	N/A	--	N/A	--	1.0E-03	1.0E+01	N/A	--

6.6. ANALYSIS FOR MARINE TRANSPORT

The activities associated with the handling of the ton containers at the original storage site (Aberdeen Proving Ground, APG) and at the receiving site (Johnston Atoll, JA) differ from those for other transport options. In brief, the Army's plan is to package the ton containers in vaults to protect them against impact, crush, puncture, fire, and immersion while being transported. At the sending site the munitions will be subjected to a few handling operations during their movement to the loading dock for offsite ship transportation. Regarding the receiving site (JA), this analysis addresses only the handling activities associated with the unloading of the vessel and of the lighters since information is lacking on the remaining process activities at the atoll.

The handling operation differences between the offsite transport modes are described in Section 6.2. Further details on the marine transport activities are as follows:

1. The vaults will be loaded onto a truck by forklift for transfer to the loading dock on the Bush River.

2. At the loading dock, a crane is used to lift the vault from the truck and to load it on the lighter.

3. Ten lighters will be towed to the ocean-going LASH vessel anchored in the deeper water of the Chesapeake Bay.

4. The lighters will be loaded on the LASH vessel using a shipboard crane. The LASH vessel will then sail southward in the Chesapeake Bay.

5. At the receiving site (JA) the lighters and the vaults will be unloaded from the LASH vessel using the same handling equipment as the one used at the sending site.

Eight accident sequences were identified for the handling activities taking place at the sending site (APG). Only four accident sequences are identified for the receiving site, since this analysis stops after the lighter and the vault have been unloaded from the LASH vessel. Table 6-8 shows the list of accident sequences for both the sending and the receiving sites, since differences in agent release dispersion will apply depending on which site the accident occurs. The event tree models for the generic accident scenarios presented in Section 6.3 still apply. The additional event for the lighter drop accident consists only of the initiating event and the conditional probability that the vault will be crushed. The release sequence is designated as HW34.

Table 6-9 presents the input data used for the accident frequency analysis. The basis for the initiating events frequencies and for the conditional events probability have been discussed in Section 6.3. The probability of crush of the ton container is new and is discussed in the following. The supporting analysis is found in Appendix C.

The probability of crushing the ton container as a result of dropping the lighter containing the vault has been evaluated based on a simple one dimensional impact model. The results of this analysis indicates that if a lighter is dropped 70 ft to the bottom of the vessel during loading operations, the 56 vaults and ton containers at the bottom of the lighter will fail. In the case where a lighter is accidentally dropped on another lighter already on the vessel, no munition is expected to fail.

The resulting sequence frequencies and uncertainties are summarized in Table 6-10 for the marine transport option.

TABLE 6-8
ACCIDENT SCENARIOS FOR MARINE TRANSPORT OPTION HANDLING ACTIVITIES

Sending Site

HW01	Drop of ton container at storage area (no vault)
HW02	Forklift collision with short duration fire at storage area (no vault)
HW04	Forklift collision without fire at storage area (no vault)
HW05	Drop of vault
HW06	Forklift (or crane) collision with fire involving vault
HW07	Forklift (or crane) collision without fire involving vault
HW26	Collision accident (no vault) with prolonged fire leads to thermal detonation
HW34	Drop of lighter while handled with shipboard crane (vault crush)

Receiving Site

HW05	Drop of vault
HW06	Forklift (or crane) collision with fire involving vault
HW07	Forklift (or crane) collision without fire involving vault
HW34	Drop of lighter while handled with shipboard crane (vault crush)

TABLE 6-9
INITIATING AND CONDITIONAL EVENTS FREQUENCIES (MARINE TRANSPORT)

	INITIATING EVENT	FREQUENCY EVENTS/OP	ERROR FACTOR	REFERENCE	APPLICABLE SCENARIO
(B)	(C) (D) (E) (F) (G) (H)	(I)	(J)	(K) (L)	(M)
HE10	Pallet or container dropped during handling of non-leaking munition outside the MDB (1)	3.0E-06	10.0		H01,H05,
HE55	Vehicle collision accident	4.3E-06	10.0	GA derived data, see details in App. F	H02,H04, H026

CONDITIONAL EVENTS PROBABILITIES

	EVENT SEQUENCE	EVENT PROBABILI	ERROR FAC.	REFERENCE	APPLICABLE SCENARIO
HE100K	Ton Container punctured given a drop (drop height = 6ft.)	3.34E-03	3.0		H01
HE110K	Vault and ton container punctured given a drop of vault	4.90E-04	3.0		H05,H06,
HE140K	Ton container punctured given a drop resulting from collision (drop height = 2ft.)	1.68E-03	3.0		H02,H04
HE150K	Ton container crushed given a drop of the lighter	1.00E+00			H034
HE550	Fire results from vehicle collision	7.25E-02	10.0		H02,H06,
HE555	Collision does not cause fire	9.27E-01	none		H04,H07
HE560	Fire contained within				
HE560B	30 min - non-burstered munition	1.00E+00	none		H02
HE560C	>4 hrs - vault	1.00E+00	none		H06
HE570	Fire not contained within				

TABLE 6-9 (Continued)

HE570B	30 min - Non-burstered munition	0.00E+00	none	H026
HE580	Munition ruptures given prolonged fire	1.00E+00		H026

TABLE 6-10
FREQUENCIES OF HANDLING ACCIDENTS FOR MARINE TRANSPORT OPTION

BARGE TRANSPORTATION OPTION FOR TON CONTAINER FROM APG TO JOHNSTON ATOLL
Handling accidents per ton container
Accident Frequencies - Sending Site (APG)

(B) SCEN-ARIO	(C) OP.	(D) NO.	(E) ANAD FREQ	(F) RANGE FACTOR	(G) APG FREQ	(H) RANGE FACTOR	(I) LBAD FREQ	(J) RANGE FACTOR	(K) NAAP FREQ	(L) RANGE FACTOR	(M) PBA FREQ	(N) RANGE FACTOR	(O) PUDA FREQ	(P) RANGE FACTOR	(Q) TEAD FREQ	(R) RANGE FACTOR	(S) UMDA FREQ	(T) RANGE FACTOR
HWKHS		1	N/A	--	2.0E-08	12.8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
HWKHS		2	N/A	--	5.2E-10	31.1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
HWKHS		4	N/A	--	6.7E-09	12.8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
HWKHS		5	N/A	--	5.9E-09	12.8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
HWKHS		6	N/A	--	3.1E-10	31.1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
HWKHS		7	N/A	--	3.9E-09	12.8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
HWKHS		26	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
HWKHS		34	N/A	--	6.0E-06	10.0	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--

Accdent Freq. Receiving Site

SCEN-ARIO	OP.	NO.	JA FREQ	RANGE FACTOR
(B)	(C)	(D)	(E)	(F)
HWKHS		5	2.9E-09	12.8
HWKHS		6	3.1E-10	31.1
HWKHS		7	3.9E-09	12.8
HWKHS		26	N/A	--
HWKHS		34	6.0E-06	10.0

6.7. REFERENCES

6-1. "Transportation of Chemical Agent and Munitions: A Concept Plan," Final Report prepared for PEO-PM Cml Demil by MITRE Corp., 30 June 1987.

6-2. List of Assumptions in letter from GA to OPMCM dated April 29, 1987.

6-3. "Probabilities of Selected Hazards in Disposition of M55 Rockets," M55-CS-02, USATHAMA, September 22, 1985.

6-4. "Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications," NUREG/CR-1278, U.S. Nuclear Regulatory Commission, August 1983.

7. SCENARIO LOGIC MODELS FOR PLANT OPERATIONS

7.1. INTERNAL EVENTS

The discussion presented in the following paragraphs and the discussion and figures presented in Sections 7.1.1 through 7.1.4 have been taken from documentation provided by JBF Associates, Inc. with only minor editing. The material presented in Section 7.1.5 is based on material supplied by JBF Associates, Inc. but has been augmented by GA to address explosions occurring in the incineration systems.

The development of plant operations accident scenarios involved systematically evaluating each functional area of the plant to identify initiating events which, if unchecked, could lead to agent releases above the screening thresholds set by MITRE. Then, for each initiating event, possible successes and failures of the plant systems that have the potential to check the release of agent were considered. Event trees were used to identify the possible modes of accident progression.

All of the initiating events considered for the analysis of internal events are in the following categories:

1. Agent spills.
2. Detonations.
3. Fires.
4. Process upsets.

Accidents initiated by external events are discussed in Section 7.2.

Event trees show the possible modes of accident progression. The events included in the event trees are successes and failures of functions (plant systems and/or operator actions) designed to prevent agent releases. The plant systems considered include the ventilation/filtration systems, the fire suppression systems, the explosion containment system, and the process control systems.

Each event tree contains a statement of the initiating event at the top, on the left-hand side. The functions that can limit agent releases are listed across the top of the event tree. The event tree branches at each function. The upward path at each branch is success (yes, the stated function worked) and the downward path is failure (no, the stated function did not work).

The order in which the functions are considered is specified by the analyst according to the order in which functions are challenged unless logical considerations of the analysis dictate otherwise. An example of a case where logical considerations dictate the listed order of a function involves the ventilation system. The ventilation system is challenged immediately whenever agent is released within the plant. However, the ventilation system is considered last on most of the event trees because (1) its function may be irrelevant (e.g., if the building integrity is lost because of a fire or explosion, agent will be released regardless of whether the ventilation system works) and (2) its failure probability is a function of other conditions that may develop (e.g., a large fire may saturate the ventilation system's filters, thus increasing the probability the ventilation system fails to prevent an agent release).

The last consideration stated above applies generally to each branch in the event tree; the failure probability of each function depends on the specific conditions implied by the path that leads to a challenge of the function. In other words, the probabilities of success and failure at each branch point in the event tree are conditioned on

the occurrence of the initiating event and the successes or failures of the preceding functions along the path that leads to the challenge of the function being considered. That is why some of the event tree functions are assigned different failure probabilities within the same tree; they are challenged on different paths of the tree.

Some scenarios were screened from the analysis based on frequency considerations. If the product of the initiating event frequency and conservative estimates of the failure probabilities of plant safety systems for a scenario is less than 10^{-10}/year, that scenario was screened from further consideration (Ref. 7-1). (The initiating event frequencies and system failure probabilities used for screening are shown on the event trees.) Other scenarios were screened based on successful operation of plant safety systems preventing significant agent releases.

Each accident scenario on each event tree is labeled with a "C" if it has been screened based on low consequence, an "F" if it has been screened based on low frequency, or a scenario identified if it is being analyzed.

A discussion of the data, and its basis, used in quantifying the fault trees and event trees is provided in Section 9.1.

7.1.1. Explosive Containment Room Vestibule and Munitions Corridor

The analysis reported in this section examined potential release scenarios that could occur in the Explosive Containment Room Vestibule (ECV) or Munitions Corridor. These scenarios all involve damage to one or more munitions or containers of agent with subsequent catastrophic

failure of the building structure or ventilation system. This analysis considered the following types of initiating events:

1. Simple spills of munitions that would create an evaporative source of agent greater than the screening thresholds discussed earlier.

2. Detonations of munitions that would result in a source of agent vapor greater than the screening thresholds.

3. Fires that cause rupture or damage of munitions, thereby creating a source of agent greater than the screening thresholds.

For Type 1 initiators, spills of one or two of each munition or container type were analyzed. For all munitions, it was assumed that spills of more than two at a time will not occur. It was also assumed that all processing operations will make use of two identical conveyor lines. Upsets that cause munition damage in both lines will most likely be detected immediately by some of the many sensors that monitor the system status on a continuous basis. Early detection should result in shutdown of the conveyor lines before additional munitions are damaged.

The principal mechanisms considered for munition spills in the ECV/Munitions Corridor include falls of munitions from the conveyors, resulting in puncture damage to the casings, and equipment failures (e.g., failures of conveyor stops or control system logic) that cause the munitions to fall from the conveyors.

For Type 2 initiators, detonations of one of each munition type that contains explosive components were analyzed. The principal mechanism considered for detonations in the ECV/Munitions Corridor includes falls of munitions from the conveyor with detonation on impact.

A detonation of an 8-in. projectile in the ECV will cause failure of the building and direct release of agent vapors to the environment.

Type 3 initiators were not analyzed. A fire of sufficient intensity and duration to rupture or detonate a munition or agent container is not credible for the ECV/Munitions Corridor due to the low inventory of combustibles in these areas. However, there are ignition sources in these areas (e.g., motors and cables). Therefore, scenarios involving fire subsequent to an agent spill or munition detonation were considered.

The event trees developed for initiating events in the ECV with estimated frequencies above the screening threshold are shown in Figs. 7-1 through 7-4. The ventilation system event was quantified using the fault tree presented in Fig. 7-5. Table 7-1 defines the event tree functions.

The following is a summary of the assumptions used in developing these event trees:

1. All processing operations will use two identical conveyor lines.

2. Upsets that cause munition damage in two conveyor lines at once will be detected immediately.

3. Detonations of 8-in. projectiles in the ECV will cause structural failure of the MDB, resulting in direct agent release to the environment, based on performed analysis.

4. A fire (as an initiating event) of sufficient intensity and duration to rupture or detonate a munition or agent container is not credible for the ECV/Munitions Corridor due to the low combustible inventory in these areas.

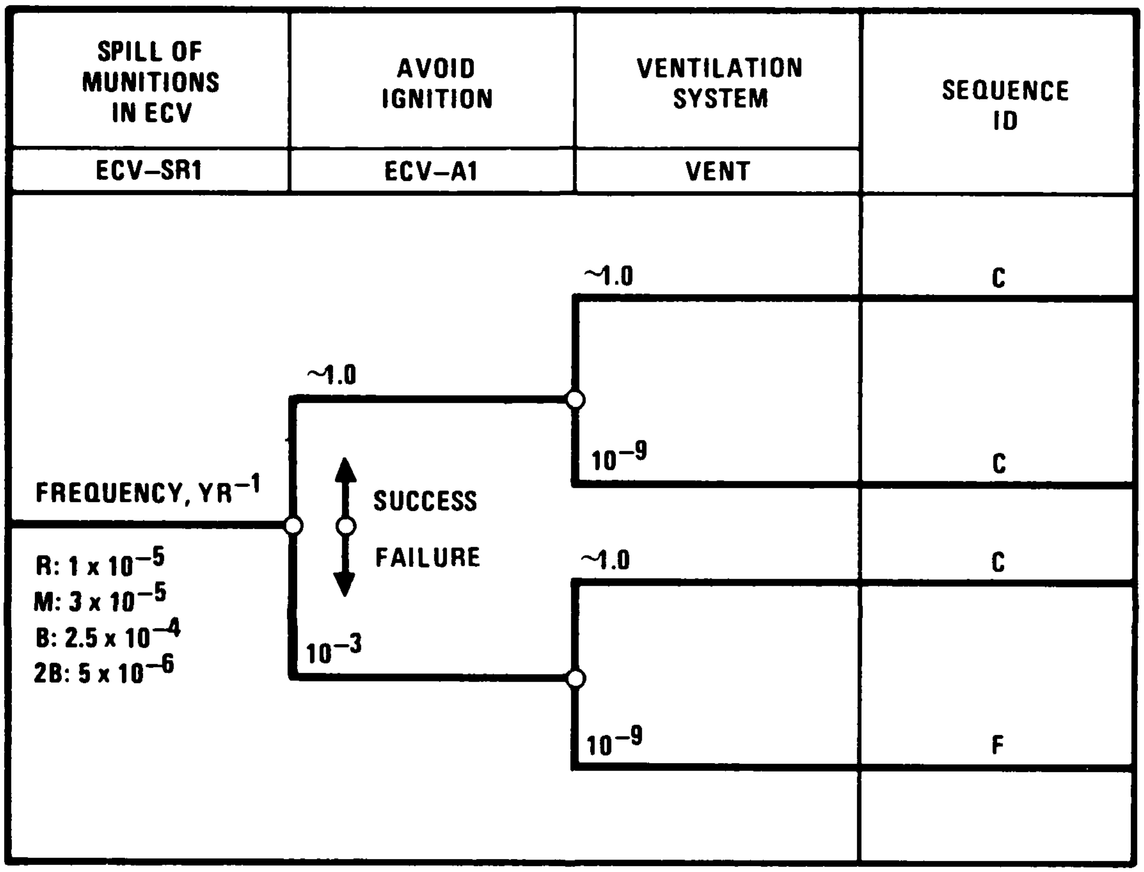


Fig. 7-1. Event tree for spill of munition(s) in the ECV

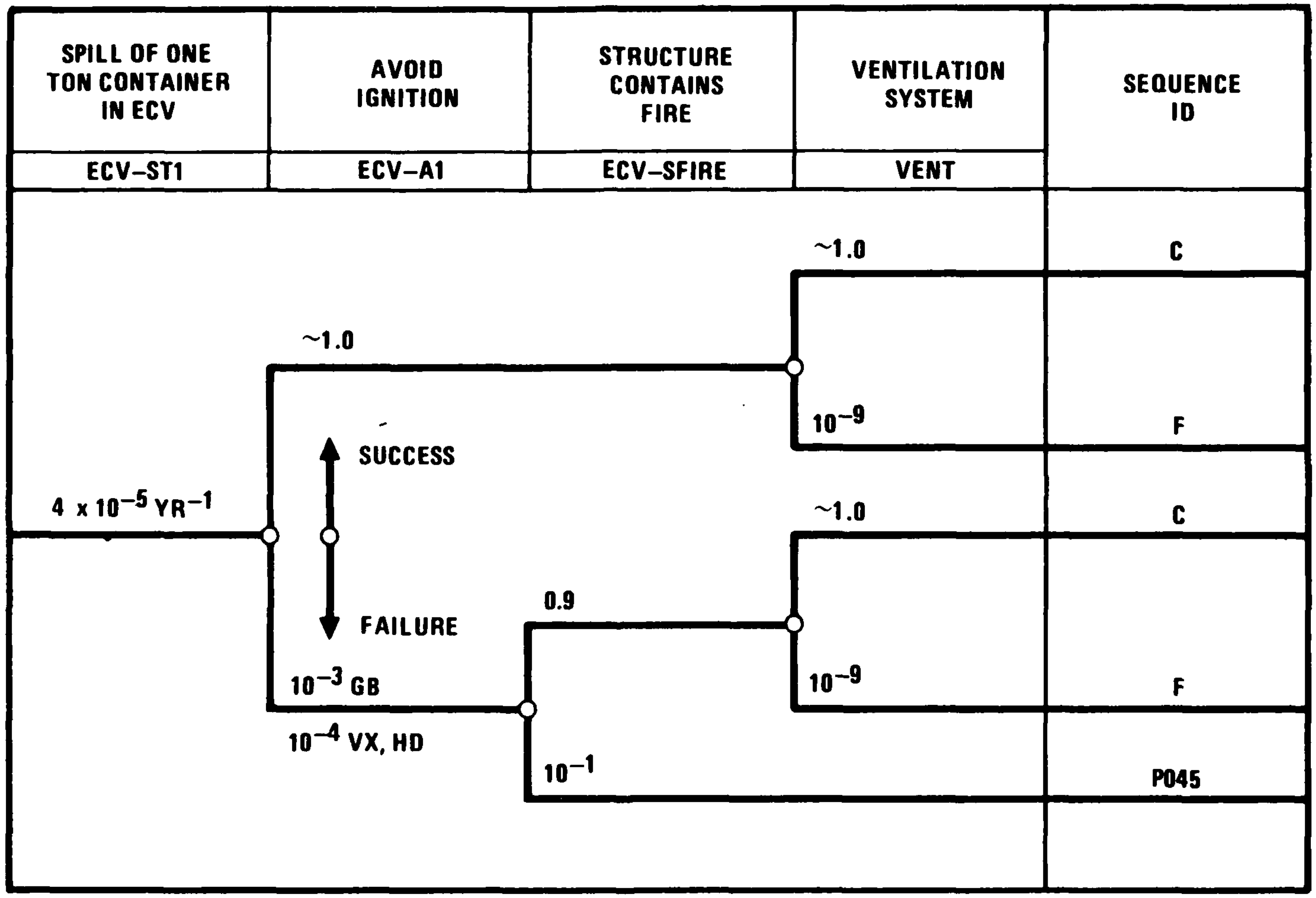


Fig. 7-2. Event tree for spill of one ton container in ECV

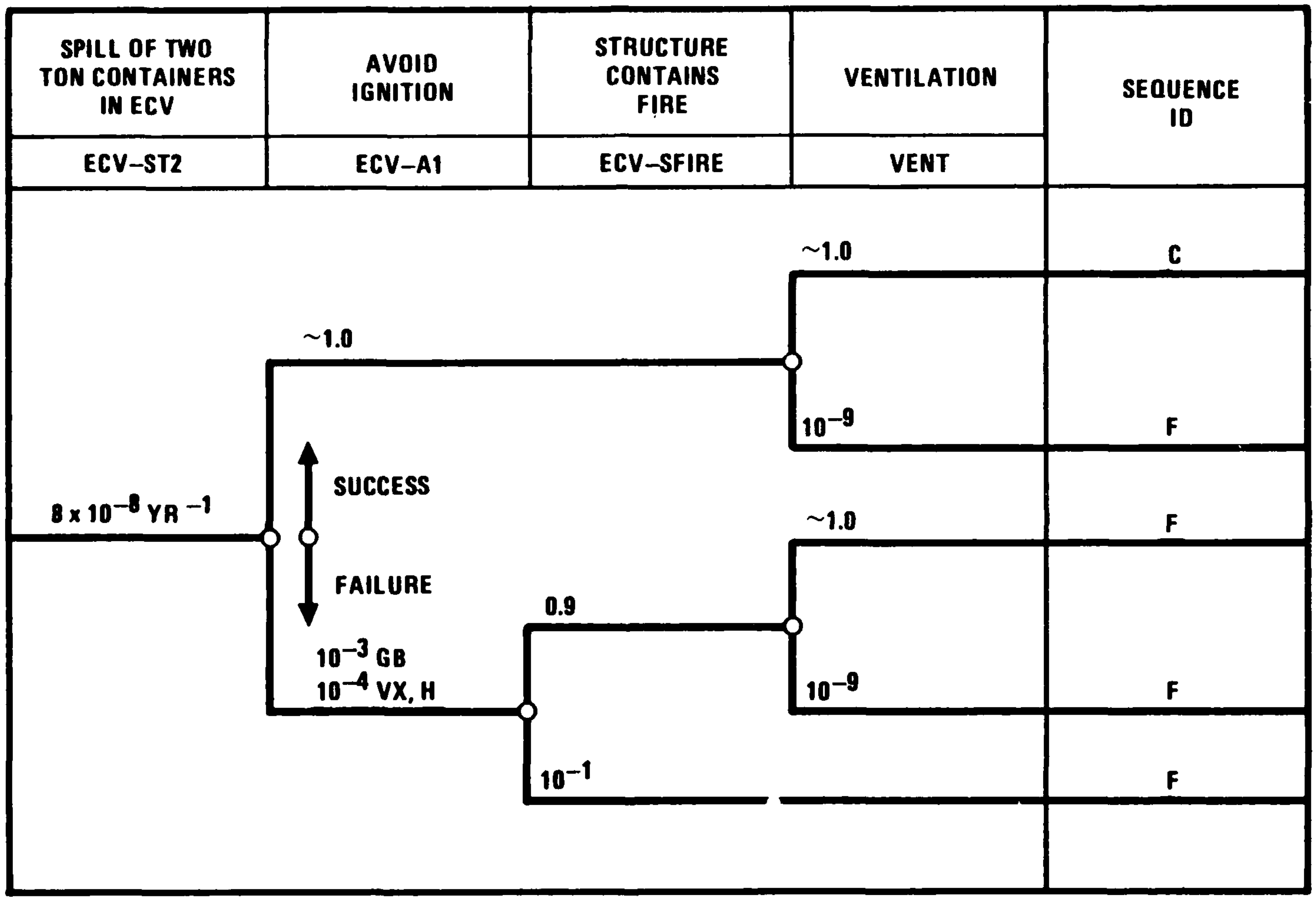


Fig. 7-3. Event tree for spill of two ton container in ECV

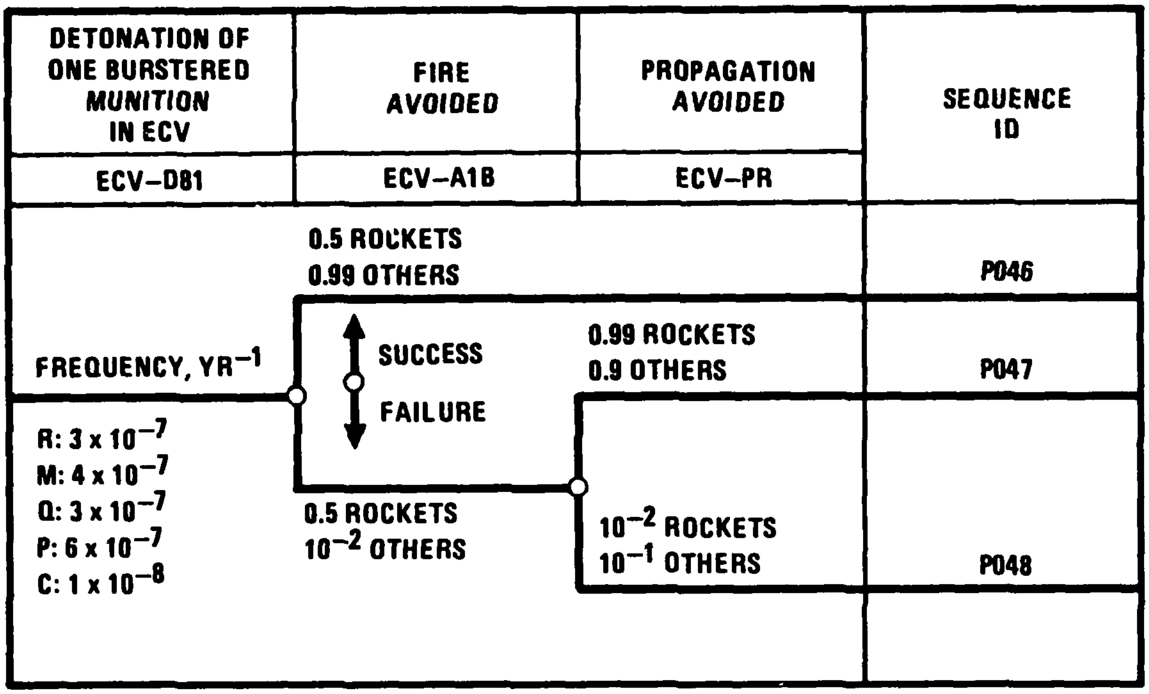


Fig. 7-4. Event tree for detonation of burstered munition in ECV

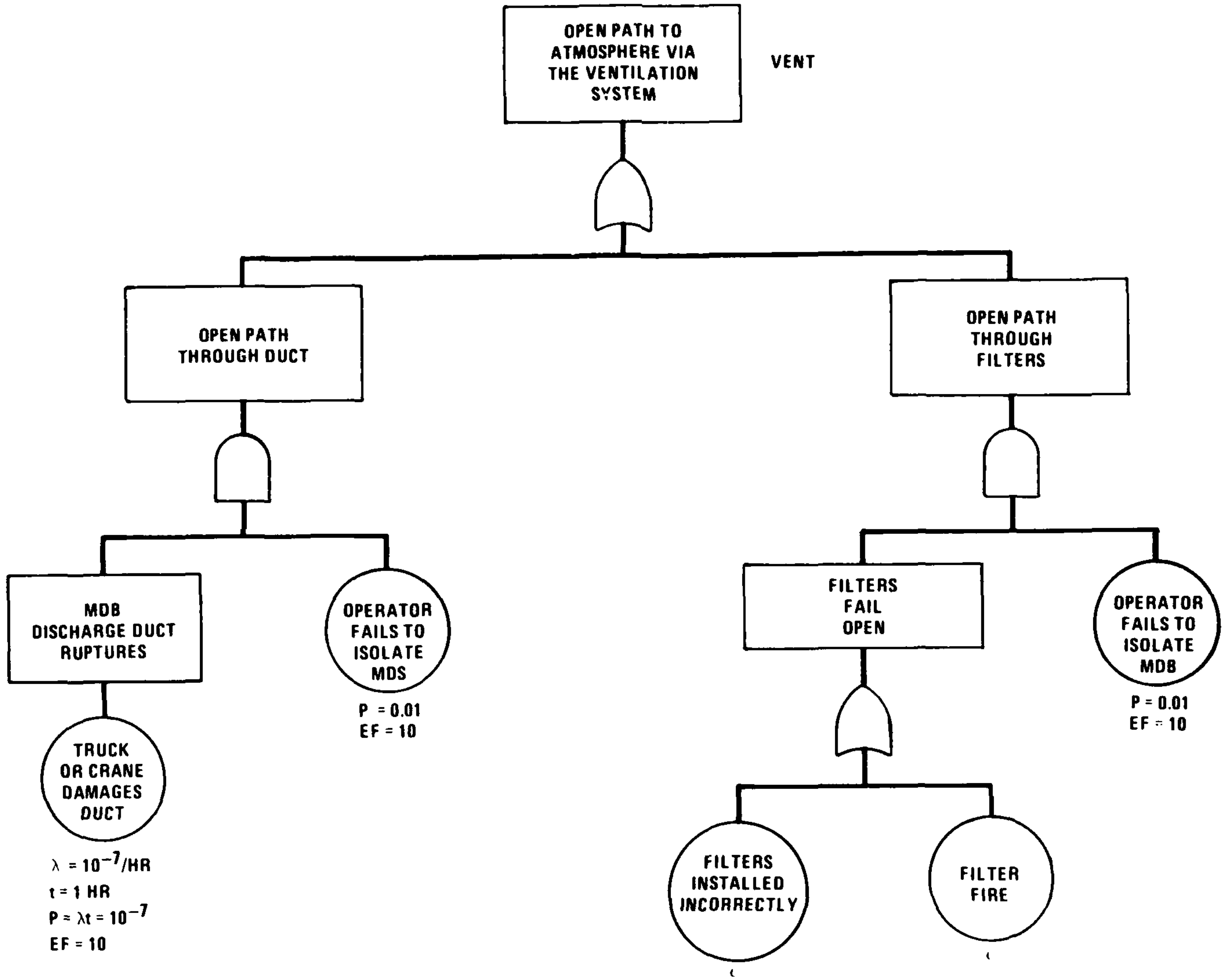


Fig. 7-5. Fault tree for agent release through the ventilation systems

TABLE 7-1
EVENTS CONSIDERED FOR THE ECV/MUNITIONS CORRIDOR

Event	Description
Spill of one rocket in ECV (ECV-SR1)	One rocket falls off the conveyor due to a process upset or improper loading and is punctured. The spill is not cleaned up in 1 h.
Spill of one mine in ECV (ECV-SM1)	One mine falls off the input conveyor due to a process upset or improper loading and is punctured. The spill is not cleaned up in 1 h.
Spill of two bombs in ECV (ECV-SB2)	One tray of bombs falls off a bypass conveyor due to improper loading or switch failures that prevent the conveyor stop from being raised until the charge can arrives. The bombs are punctured, and the spill is not cleaned up in 1 h.
Spill of one ton container in ECV (ECV-ST1)	One ton container falls off a bypass conveyor due to improper loading or switch failures that prevent the conveyor stop from being raised until the charge car arrives. The container is punctured, and the spill is not cleaned up in 1 h.
Spill of two ton containers in the ECV/COR (ECV-ST2)	One ton container on each line is damaged when a control system failure prevents the stops at the ends of the bypass conveyors from being raised when the charge car is unavailable. The containers are punctures, and the spill is not cleaned up in 1 h.
Detonation of one rocket in ECV (ECV-DR1)	A rocket falls off the input conveyor and detonates.
Detonation of one mine in ECV (ECV-DM1)	A mine falls off the input conveyor and detonates.
Detonation of one 8-in. projectile in ECV (ECV-D81)	A projectile falls off a conveyor and detonates.
Detonation of one 105-mm projectile in ECV/COR (ECV-D1051)	A projectile falls off a conveyor and detonates.

TABLE 7-1 (Continued)

Event	Description
Detonation of one 155-mm projectile in ECV/COR (ECV-D1551)	A projectile falls off a conveyor and detonates.
Avoid ignition (ECV-AI)	Failure on this event tree branch implies ignition of an agent spill. Motors and cables are potential ignition sources in the ECV.
Avoid ignition (ECV-AIB)	Failure on this event tree branch implies ignition of agent vapors and/or liquid agent spills following a munition detonation. Motors and cables are potential ignition sources in the ECV.
Ventilation system (VENT)	Failure on this event tree branch implies a release of agent through the ventilation system due to (1) duct failure or (2) filter failures. (See fault tree in Fig. 7-5.)
Propagation Avoided (ECV-PROP)	Failure on this event tree branch implies that fragments from a detonated munition hit other munitions in the ECV or the unpack area causing additional agent spillage.

5. Fires in the ECV/Munitions Corridor will not be suppressed since there are no fire suppression systems and personnel will not be sent in to fight a fire.

7.1.2. Munition Processing Systems

The analysis reported in this section examined potential failures involving all seven of the munitions processing systems. They include:

- Mine machine (MIN).
- Rocket shear machine (RSM).
- Rocket punch and drain station (RDS).
- Projectile/mortar disassembly machine (PMD).
- Burster size reduction (BSR) machine.
- Bulk drain station (BDS).
- Multipurpose demilitarization machine (MDM).

This evaluation assumed that the machines are capable of processing munitions at designed rates by completely draining agent and disassembling munitions. Also, any situation that prevents the machines from attaining those design parameters requires that the machine be shut down.

Based on these assumptions the following types of events were evaluated for each machine:

1. Simple spills of munitions that would create an evaporative source of agent greater than the screening thresholds discussed earlier.

2. Detonations of munitions that would result in a source of agent vapor greater than the screening thresholds.

3. Fires that cause rupture or damage of munitions, thereby creating a source of agent greater than the screening thresholds.

For Type 1 initiators, spills of one or more of each munition or container type were analyzed. The mechanisms considered for munition spills in the ECR or MPB include (1) random falls of munitions from the conveyors, resulting in puncture damage to the casings, (2) equipment failures (e.g., failures of conveyor stops or control system logic) that cause the munitions to fall from the conveyors, and (3) equipment failures (e.g., shearing of a partially drained rocket) that cause munitions to be processed improperly.

For Type 2 initiators, detonations of one of each munition type that contains explosive components were analyzed. The mechanisms considered for detonations in the ECR or MPB include (1) falls of munitions from the conveyor with detonation on impact and (2) process upsets or equipment failures (e.g., loss of water spray during rocket shearing) that cause munitions to be processed improperly.

It was assumed that the ECR is likely to contain a blast within its confines since it is designed and constructed to do so.

Type 3 initiators were not analyzed. A fire of sufficient intensity and duration to rupture or detonate a munition or agent container is not credible for the ECR or MPB due to the low inventory of combustibles in these areas. However, there are ignition sources in these areas (e.g., motors and cables). Therefore, scenarios involving fire subsequent to an agent spill or munition detonation were considered.

Figures 7-6 through 7-8 show the event trees for the munitions processing systems. The ventilation system event was quantified using

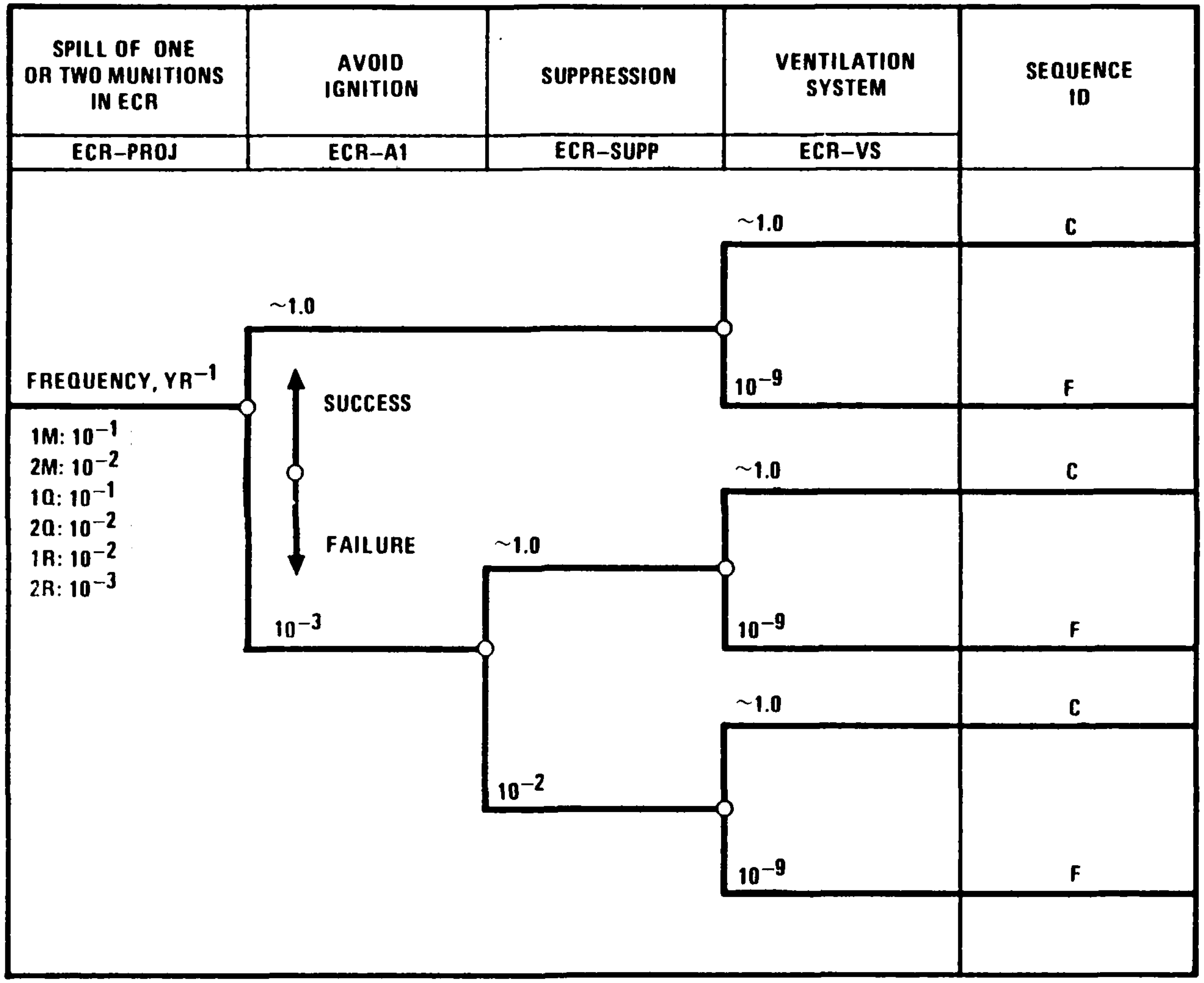


Fig. 7-6. Event tree for spill of munition(s) in the ECR

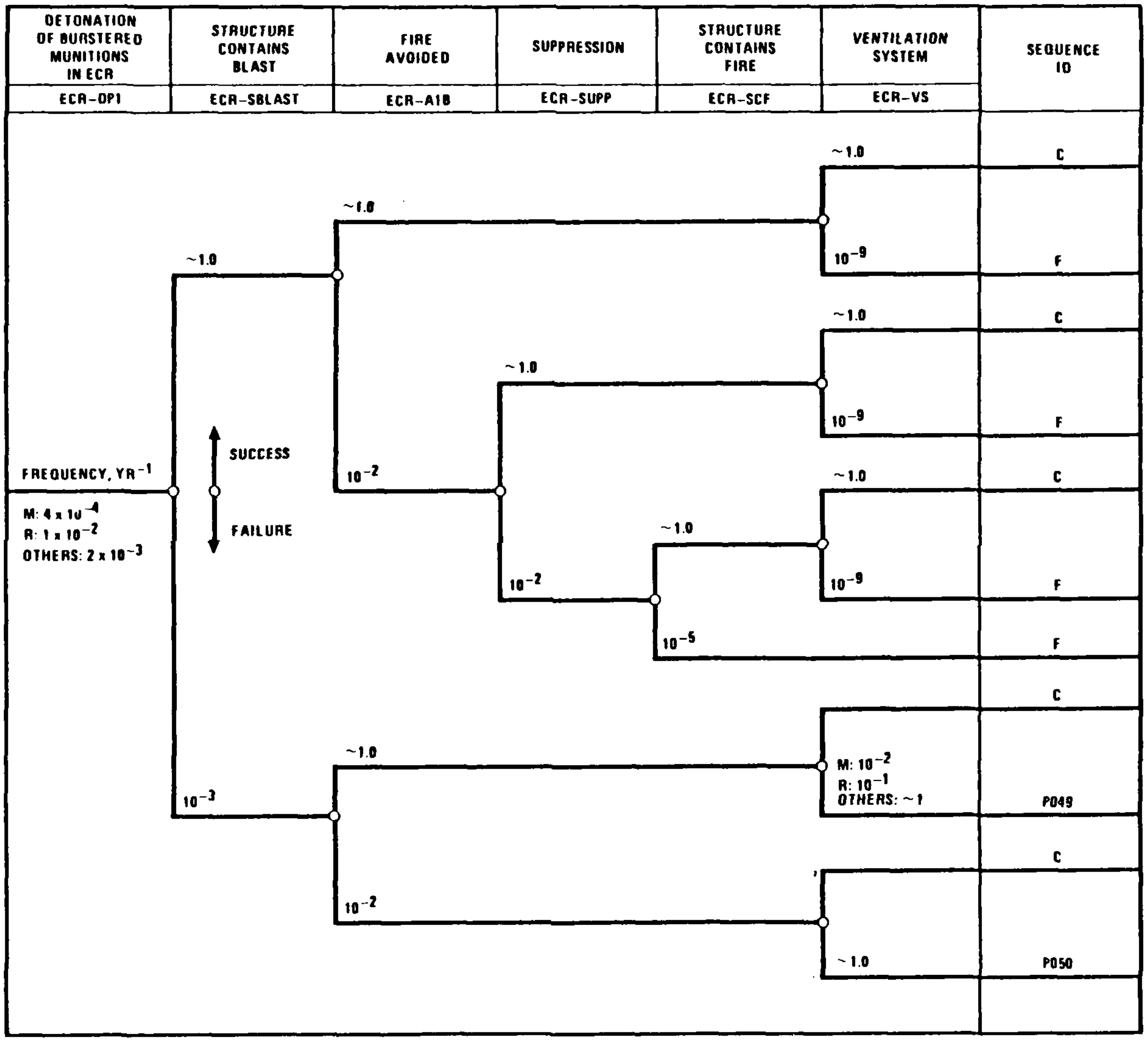


Fig. 7-7. Event tree for detonation of burstered munitions in the ECR

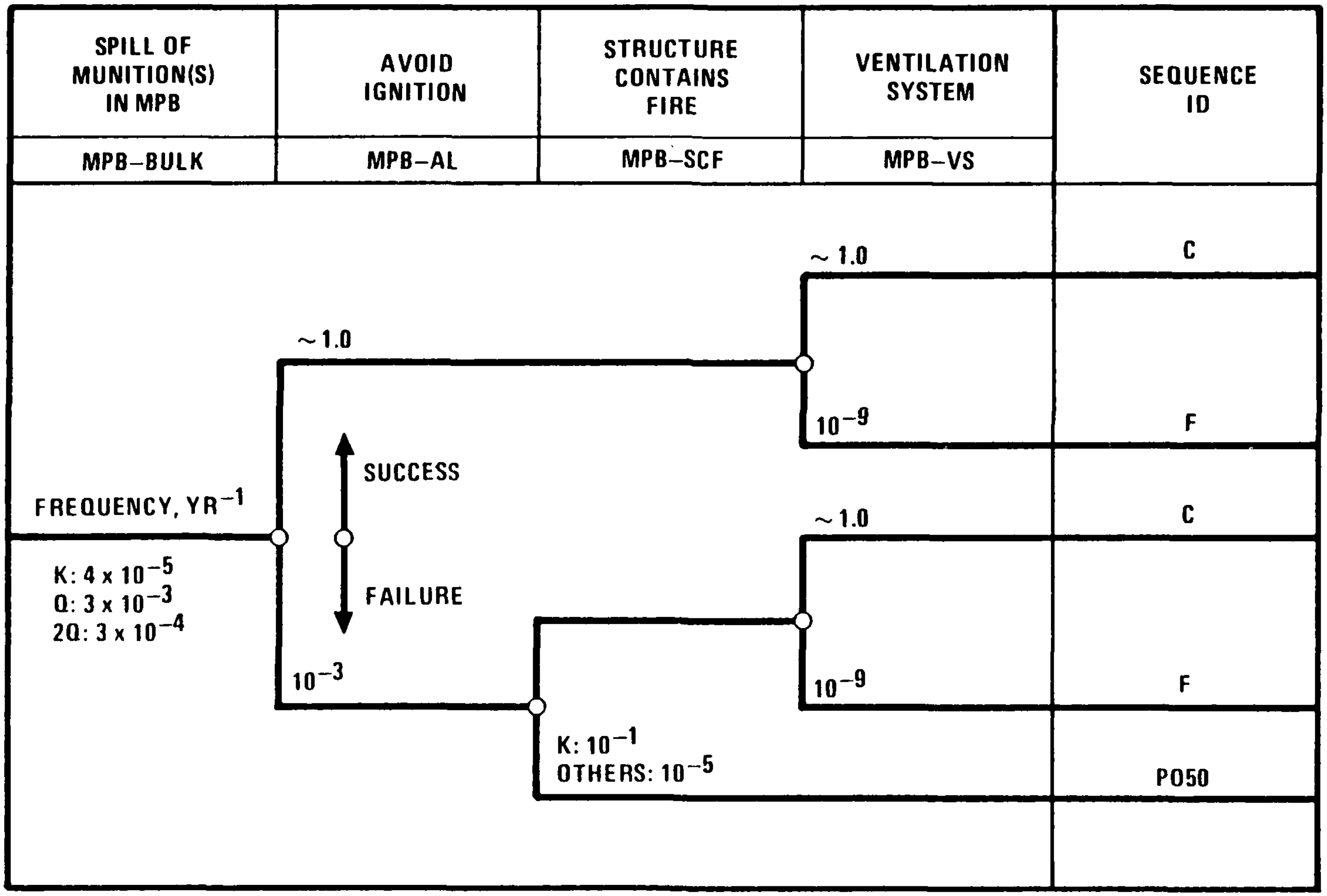


Fig. 7-8. Event tree for spill of munition in MPB

the fault tree presented in Fig. 7-5. Table 7-2 defines the event tree functions.

The following is a summary of the assumptions we made in developing these event trees:

1. All processing operations will use two identical conveyor lines.

2. Upsets that cause munition damage in two conveyor lines at once will be detected immediately.

3. Agent reservoirs within munitions are at or near atmospheric pressure.

7.1.3. Buffer Storage Area

The analysis reported in this section examined potential release scenarios that could occur in the Buffer Storage Area (BSA) on the first floor of the MDB. The BSA contains only conveyors that hold drained munitions and containers (projectiles, cartridges, bombs, and ton containers) awaiting decontamination in the Metal Parts Furnace. The only items that will contain a significant amount of residual agent after being drained are ton containers. These containers could contain 75 to 85 lb of residual agent. Therefore, the spill of one drained ton container in the BSA was analyzed. To account for the chance that an undrained munition or container could be in the BSA (due to failures in the Bulk Drain Station or the Multipurpose Demilitarization Machine), the spill of one full ton container was also analyzed. Other undrained munitions could also spill their contents in the BSA; the full ton container was selected as a representative worst-case spill for this area.

TABLE 7-2
EVENTS CONSIDERED FOR THE MUNITION PROCESSING SYSTEMS

Event	Description
Spill of mine in ECR (ECR-MIN)	Any process upset resulting in the release of the agent inventory of a mine in the ECR.
Avoid ignition (ECR-AI)	Failure on this event tree branch implies ignition of an agent spill. Motors and cables are potential ignition sources in the ECR.
Suppression (ECR-SUPP)	Failure on this event tree branch implies that the dampers for inlet ventilation to the ECR do not close.
Ventilation system (ECR-VS)	Failure on this event tree branch implies a release of agent through the ventilation system.
Spill of two mines in ECR (ECR-MINES)	Any process upset resulting in the release of the agent inventory of two or more mines in the ECR.
Spill of 8-in. projectile in ECR (ECR-PROJ)	Any process upset resulting in the release of the agent inventory of 8-in. projectiles in the ECR.
Spill of projectiles in ECR (ECR-PROJS)	Any process upset resulting in the release of the agent inventory of 8-in. projectile in the ECR.
Spill of rocket in ECR (ECR-ROC)	Any process upset resulting in the release of the agent inventory of a rocket in the ECR.
Spill of rockets in ECR (ECR-ROCS)	Any process upset resulting in the release of the agent inventory of two or more rockets in the ECR.
Detonation of mine(s) in ECR (ECR-DM1)	Any process upset resulting in the detonation of one or more mines in the ECR.
Structure contains blast (ECR-BLAST)	Failure on this branching operator implies that the walls, ceilings, blast dampers, or blast gates of the ECR are breached by the blast.

TABLE 7-2 (Continued)

Event	Description
Avoid ignition (ECR-AIB)	Failure on this event tree branch implies ignition of agent vapors and/or liquid agent spills following a munition detonation.
Detonation of projectile(s) in ECR (ECR-DP1)	Any process upset resulting in the detonation of one or more projectiles in the ECR.
Detonation of rocket(s) in ECR (ECR-DR1)	Any process upset resulting in the detonation of one or more rockets in the ECR.
Spill of bulk item in MPB (MPB-BULK)	Any process upset resulting in the release of the agent inventory of a bulk item in the MPB.
Avoid ignition (MPB-AI)	Failure on this event tree branch implies ignition of an agent spill. Motors and cables are potential ignition sources in the MPB.
Suppression (MPB-SUPP)	Failure on this event tree branch implies that the fire brigade does not successfully extinguish a fire in the MPB by spraying it with either decon solution or CO_2.
Ventilation system (MPB-VS)	Failure on this event tree branch implies a release of agent through the ventilation system.
Spill of bulk items in MPB (MPB-BULKS)	Any process upset resulting in the release of the agent inventory of two or more bulk items in the MPB.
Spill of 8-in. projectile in MPB (MPB-PROJ)	Any process upset resulting in the release of the agent inventory of an 8-in. projectile in the MPB.
Spill of projectiles in MPB (MPB-PROJS)	Any process upset resulting in the release of the agent inventory of two or more projectiles in the MPB.

TABLE 7-2 (Continued)

Event	Description
Avoid ignition (MPB-AIB)	Failure on this event tree branch implies ignition of agent vapors and/or liquid agent spills following a munition detonation.

Spills in the BSA can result from a ton container falling off the conveyor. For this analysis, it was assumed that the full container is punched at the Bulk Drain Station but not drained. Therefore, no puncture is required to release its contents.

Scenarios in which fires cause a release from the BSA were not analyzed since there are no combustibles in this area for sustaining a fire. However, there are ignition sources (motors and cables), so the possibility of an agent spill igniting was considered.

The event tree developed for the BSA is shown in Fig. 7-9. Descriptions of the events included in this tree are in Table 7-3. The ventilation event tree branch was quantified using the fault tree presented in Fig. 7-5.

The following is a summary of the assumptions used in developing the event tree shown in Fig. 7-9.

1. The Bulk Drain Station removes 95% of the agent in a munition or container under normal conditions.

2. All ton containers that reach the BSA have been punched at the Bulk Drain Station.

7.1.4. Toxic Cubicle

The analysis presented in this section examined potential release scenarios that could occur in the toxic cubicle (TOX). The only sources of agent in this area are the agent collection tanks and the agent collection and transfer lines. The scenarios which were analyzed involve spills of agent from these sources with subsequent failure of either the building structure or the ventilation system, resulting in a release of agent to the environment.

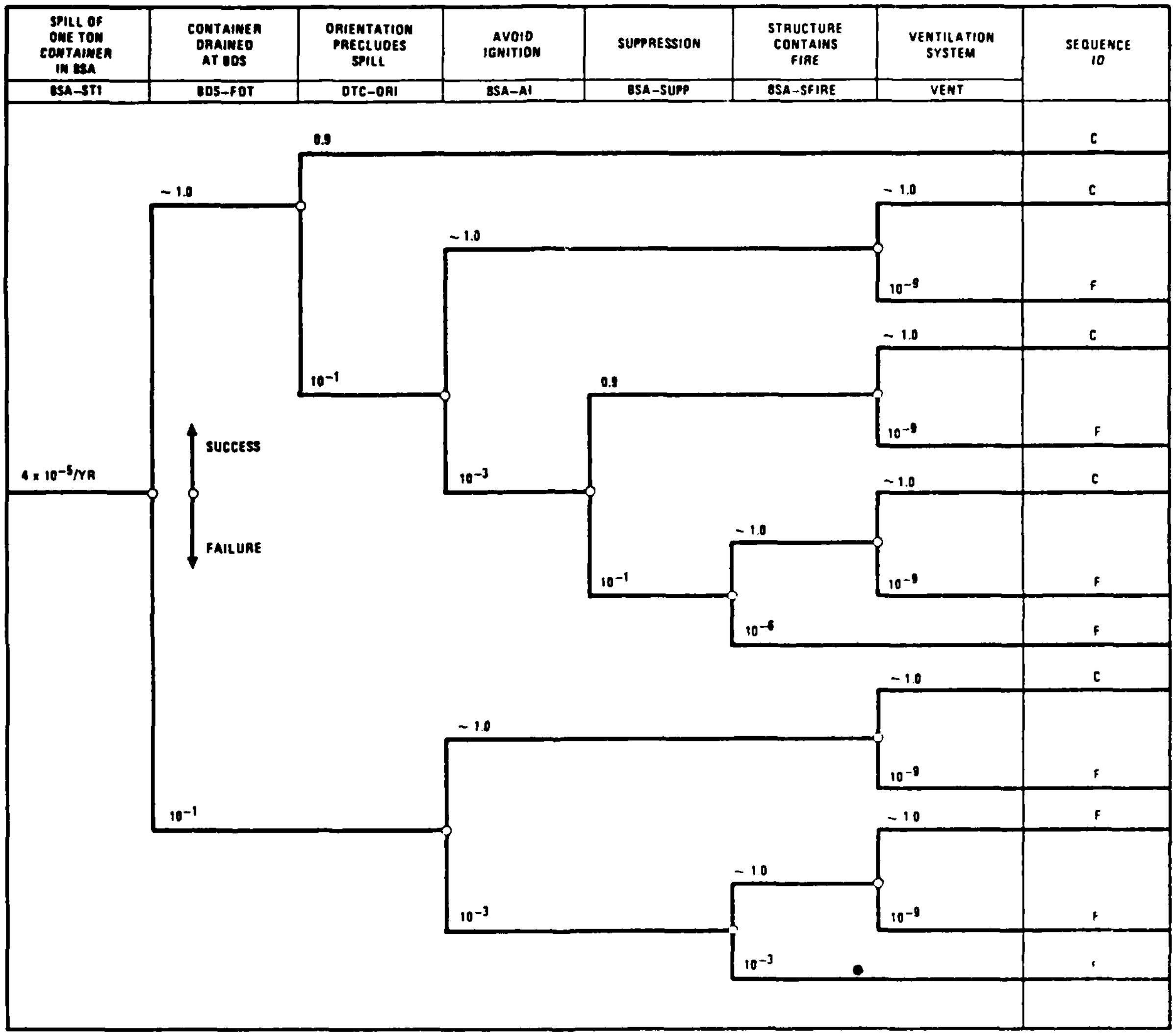


Fig. 7-9. Event tree for spill of one-ton container in the BSA

TABLE 7-3
EVENTS CONSIDERED FOR THE BSA

Spill of one ton container in BSA	A punched ton container falls off the buffer storage conveyor in the BSA.
Container drained at BDS (BDS-FDT)	Failure on this event tree branch implies that the Bulk Drain Station (BDS) did not drain a ton container before sending it on to the BSA.
Orientation precludes spill (DTC1-ORI)	Failure on this event tree branch implies that a drained ton container that is dropped lands in the proper orientation for drainage of its residual agent contents.
Avoid ignition (BSA-AI)	Failure on this event tree branch implies ignition of the agent spill. Motors and cables are potential ignition sources in the BSA.
Suppression (BSA-SUPP)	Failure on this event tree branch implies that the dampers do not successfully extinguish a fire.
Ventilation system (VENT)	Failure on this event tree branch implies a release of agent through the ventilation system due to (1) duct failure or (2) filter failures. (See fault tree shown in Fig. 7-12.)

Spills in the TOX can result from equipment ruptures (tanks, piping, or valves) or from overfilling of an agent collection tank. Rupture of a tank or of the tank outlet valves or piping would result in the spill of the entire contents of one agent collection tanks. (A 500-gal spill was assumed for this case.) On the other hand, rupture of the tank inlet valves or piping or overfilling a tank would result in a substantially smaller spill. Therefore, these two classes of spills were analyzed separately.

Scenarios in which a fire in the TOX causes a release were not analyzed since there are no combustibles in the TOX for sustaining a fire. However, there are ignition sources (motors and cables), so scenarios in which agent spills are ignited were analyzed.

The accident event trees developed for the TOX are shown in Figs. 7-10 and 7-11. Table 7-4 provides descriptions of the events used to construct these event trees, and Fig. 7-12 shows the fault tree which was constructed to quantify the fire suppression event. The ventilation system event was quantified using the fault tree presented in Fig. 7-5.

7.1.5. Incinerator Systems

7.1.5.1. Furnace Explosions. Four furnaces are used in the MDB:

1. The Liquid Incinerator (LIC).
2. The Metal Parts Furnace (MPF).
3. The Deactivation Furnace System (DFS).
4. The Dunnage Incinerator (DUN).

Analyses of explosions resulting from operating these furnaces focused upon two generic explosion scenarios:

1. Furnace explosions - in which the combustible material is initially confined to the furnace interior.

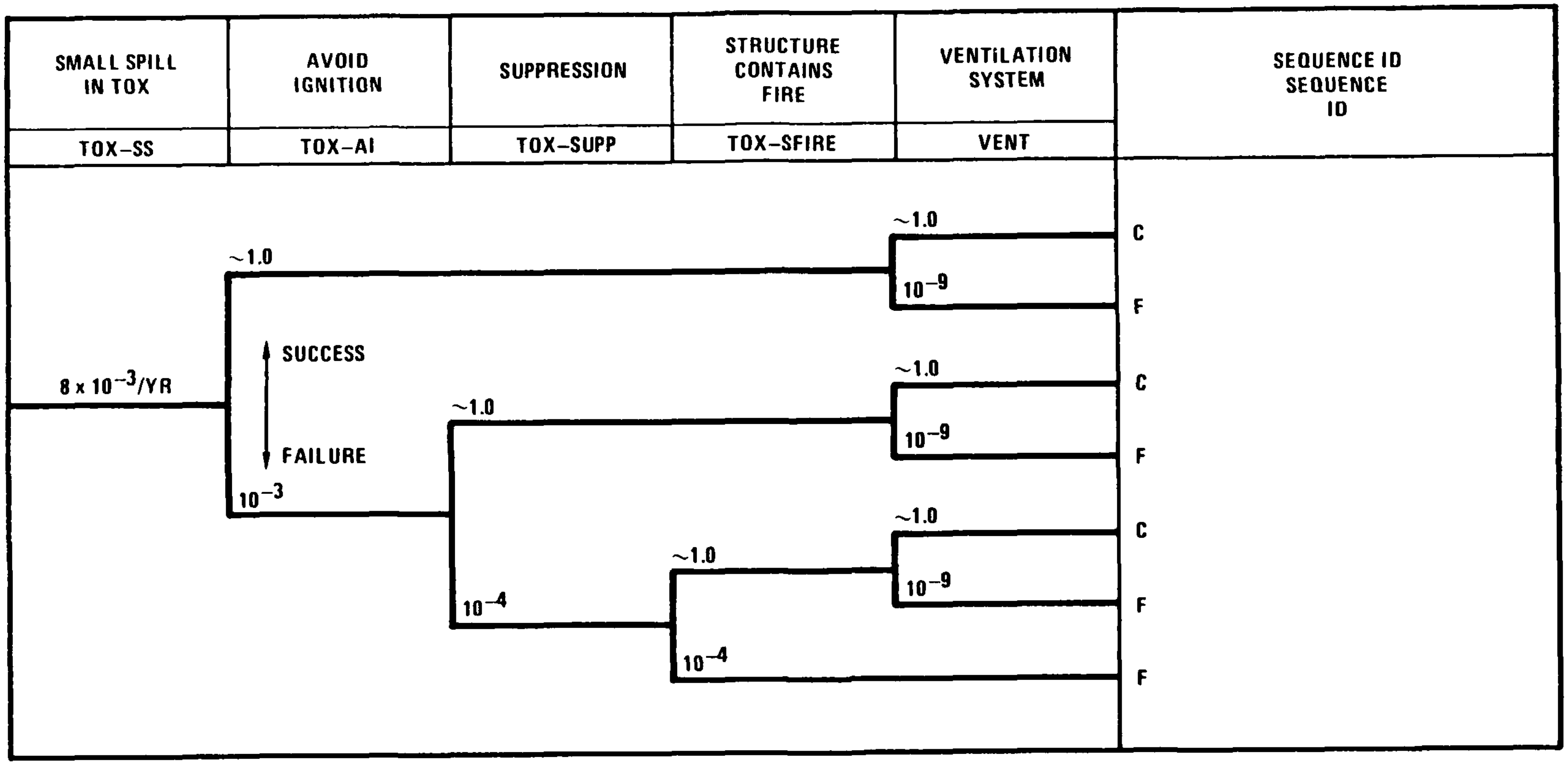


Fig. 7-10. Event tree for a small spill in the TOX

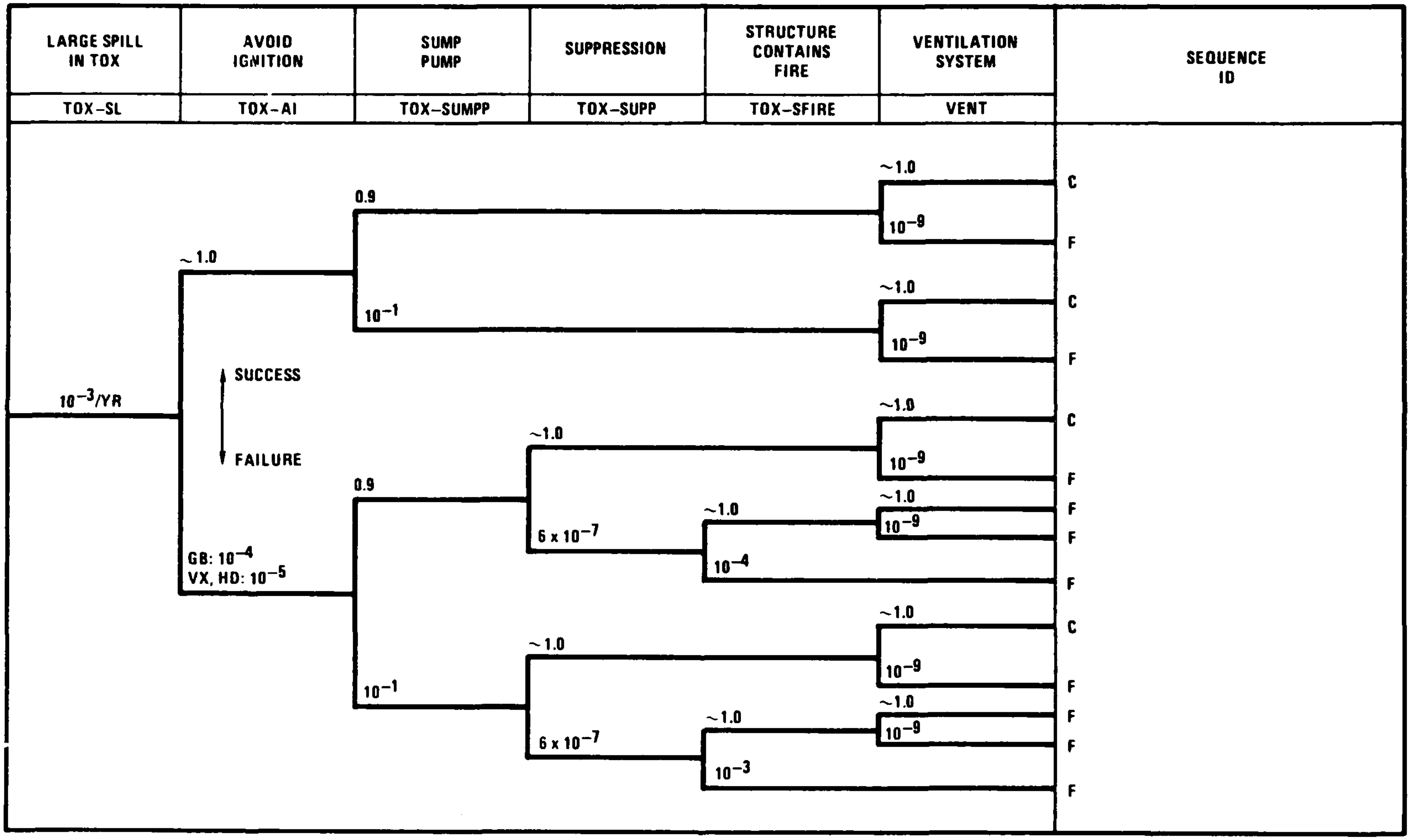


Fig. 7-11. Event tree for a large spill in the TOX

TABLE 7-4
EVENTS CONSIDERED FOR THE TOX

Event	Description
Large spill in TOX (TOX-SL)	The contents of one agent collection tank (500 gal) are spilled onto the floor of the TOX due to rupture of the tank itself or rupture of outlet valves or piping. The frequency is dominated by pipe failure with a rate of 10^{-3}/yr.
Small spill in TOX (TOX-SS)	An amount of agent less than the volume of one agent collection tank is spilled onto the floor of the TOX (typically less than 50 gal) due to tank overfill or rupture of the tank inlet piping or valves.
Avoid ignition (TOX-AI)	Failure on this event tree branch implies ignition of the agent spill. Motors and cables are potential ignition sources in the TOX. This probability was subjectively estimated.
Suppression (TOX-SUPP)	Failure on this event tree branch implies that the fire suppression system does not start and that the operator fails to either (1) close the room inlet dampers or (2) turn on the dry chemical fire suppression system. (See fault tree shown in Fig. 7-12.)
Ventilation system (VENT)	Failure on this event tree branch implies a release of agent through the ventilation system due to (1) duct failure or (2) filter failures. (See fault tree shown in Fig. 7-5.)

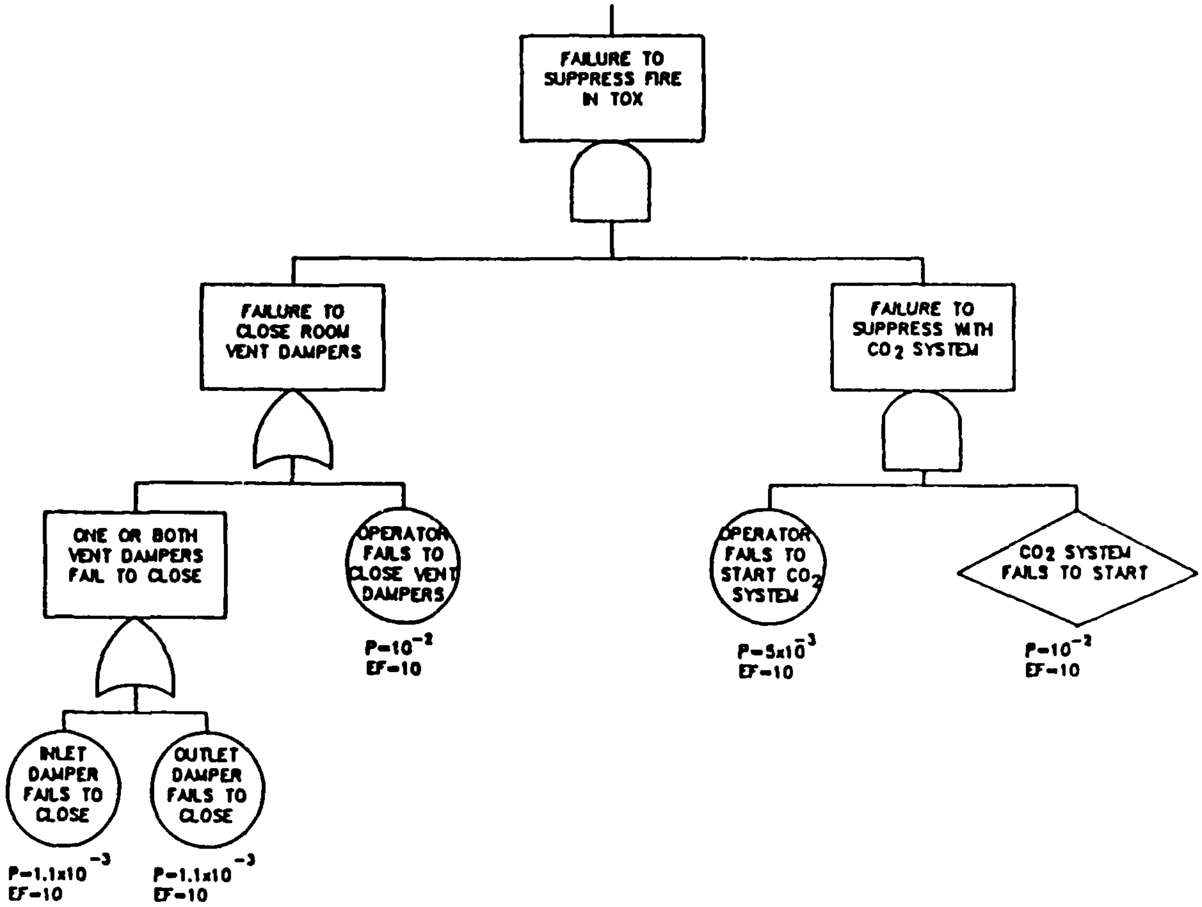


Fig. 7-12. Fault tree for failure to suppress a fire in the TOX

2. Room explosions - in which a flammable mixture forms outside of the furnace.

Room explosions do not preclude accompanying deflagration inside of the furnace.

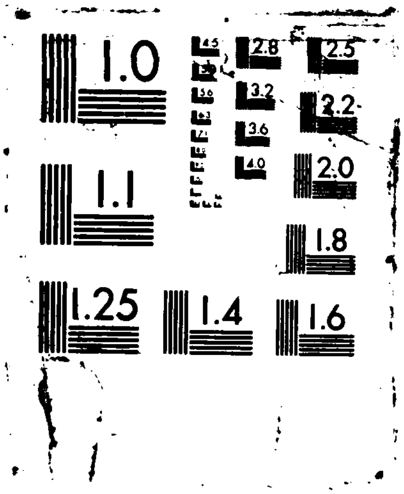
Structural evaluations show that the LIC can contain a furnace explosion. Since there is no resultant agent release to the environment, LIC furnace explosions can be screened due to their low consequence.

A LIC room explosion can occur if, following a LIC shutdown, continued agent or fuel flow into the LIC results in a flammable mixture forming in the LIC room. However, the LIC room ventilation flow rate precludes flammable mixture formation, even if 100% agent or fuel flow continues. Because of the high ventilation system reliability, the frequency of independent failures resulting in an LIC shutdown, continued fuel or agent flow, and ventilation system failure is below the 10^{-10}/yr screening criteria.

Loss of offsite power was also investigated as an LIC room explosion initiating event, because both LIC shutdown and loss of ventilation flow occur without any electric power. Thus, at frequencies on the order of 0.1 per year, a single initiating event can cause an LIC shutdown and ventilation system failure. However, the loss of offsite power terminates agent flow since, without the pressure developed by the agent feed pump, the agent cannot physically flow through the LIC atomizer. Moreover, the valves on the LIC fuel lines are designed to fail closed upon a loss of power. These design features, in conjunction with procedures requiring that the operators close the manual fuel block valves, result in the frequency of loss of offsite power initiated explosions also being below 10^{-10}/yr.

AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO CA A W BARSELL ET AL. AUG 87 GA-C-18563 5/13

UNCLASSIFIED SAPEO-CDE-IS-87000 DAAA15-85-D-0022 F/G 15/6.3 NL


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

An MPF explosion can result in an agent release to the environment if it involves an undrained or unpunched bulk item (i.e., a ton container, spray tank, or bomb). If an undrained bulk item is inadvertently fed to the MPF, the explosion involves agent deflagration. However, this type of explosion can only occur if the MPF is shut down while an undraind bulk item is being processed. Although MPF shutdowns are rather common (~7 per year), the probability of failing to drain a bulk item is so low that the frequency of an MPF explosion occurring while an undrained bulk item is being processed is below 10^{-10}/yr.

An MPF explosion will occur if an unpunched bulk item is fed to the MPF as a result of the bulk item experiencing hydraulic rupture. Hydraulic ruptures are capable of damaging the MDB and releasing virtually all of the bulk item inventory to the environment. Hydraulic ruptures have frequencies about 10^{-10}/yr.

A natural gas deflagration can also cause an MPF explosion. Since the MPF is subjected to structural failure during natural gas deflagrations, these explosions contribute to the plant risk. However, MPF room explosions are screened from the risk assessment because their frequency is below 10^{-10}/yr. This is due to the high room ventilation system reliability, a fail-safe fuel valve design, and instituted procedural requirements. Both DFS and DUN room explosions have frequencies below 10^{-10}/yr for the same reason.

Structural evaluation of DFS furnace explosions conclude that the blast is insufficient to fail the DFS room walls. Hence, any agent present when the explosion occurs will remain in the DFS room, and there will be no damage to any munitions, containers, or equipment outside of the DFS room.

The DUN furnace can contain a natural gas deflagration. Consequently, no agent release results from this scenario. However, the DUN furnace cannot survive a munition detonation. Although the probability

of inadvertently feeding a munition to the DUN is low (on the order of 10^{-7} per munition pallet or mine drum), the high munition processing rates result in DUN explosion frequencies ranging from $\sim 10^{-2}$ to $\sim 10^{-3}$ per year, depending upon the munition type. If a munition detonates in the DUN, its entire inventory is released to the environment by the detonation.

Table 7-5 describes the initiating events for LIC shutdowns. Figures 7-13 through 7-38 present the corresponding incinerator system logic models.

7.1.5.2. <u>Dunnage Incinerator Accidents Analysis</u>

<u>Mines</u>

Inadvertently feeding a mine to the Dunnage Incinerator (DUN) requires that the following three faults occur:

1. The operators mistakenly leave a mine in the dunnage box.
2. The mine counter fails.
3. The operator responsible for inspecting the dunnage box prior to charging it to the DUN fails to detect the mine.

Because of all the packing in the dunnage box, the ability of an operator to detect a mine by visual inspection is severely limited. Hence, the probability that the operator responsible for inspecting the dunnage box fails to detect the mine is essentially unity.

The mine counter has two failure modes: mechanical and human error. The dominant failure modes involves an operator failing to properly initialize the mine counter prior to unloading a drum of mines. This human error is estimated to have a 0.01 probability (Ref. 7-2).

TABLE 7-5
LIC INITIATING EVENT DESCRIPTIONS

Initiator	Description
LIC-1	These initiators are all spurious shutdown signals and process upsets which are not expected to cause agent release if no action is taken to stop the furnace operations.
	These initiators cause the loss of CA to the LIC-AB.[a]
	These initiators cause the loss of all CA to the LIC.[b]
	These initiators cause a temporary loss of fuel or CA to the LIC-AB.[c]
	These initiators cause excess feed agent to the LIC.[d]
LIC-2	These initiators cause the loss of air flow through the LIC PAS.
LIC-3	These initiators cause the loss of natural gas to all furnaces.
LIC-4	These initiators cause the loss of fuel to the lIC-AB.

[a] This initiator was previously designated LIC-5.

[b] This initiator was previously designated LIC-6.

[c] This initiator was previously designated LIC-7.

[d] This initiator was previously designated LIC-8.

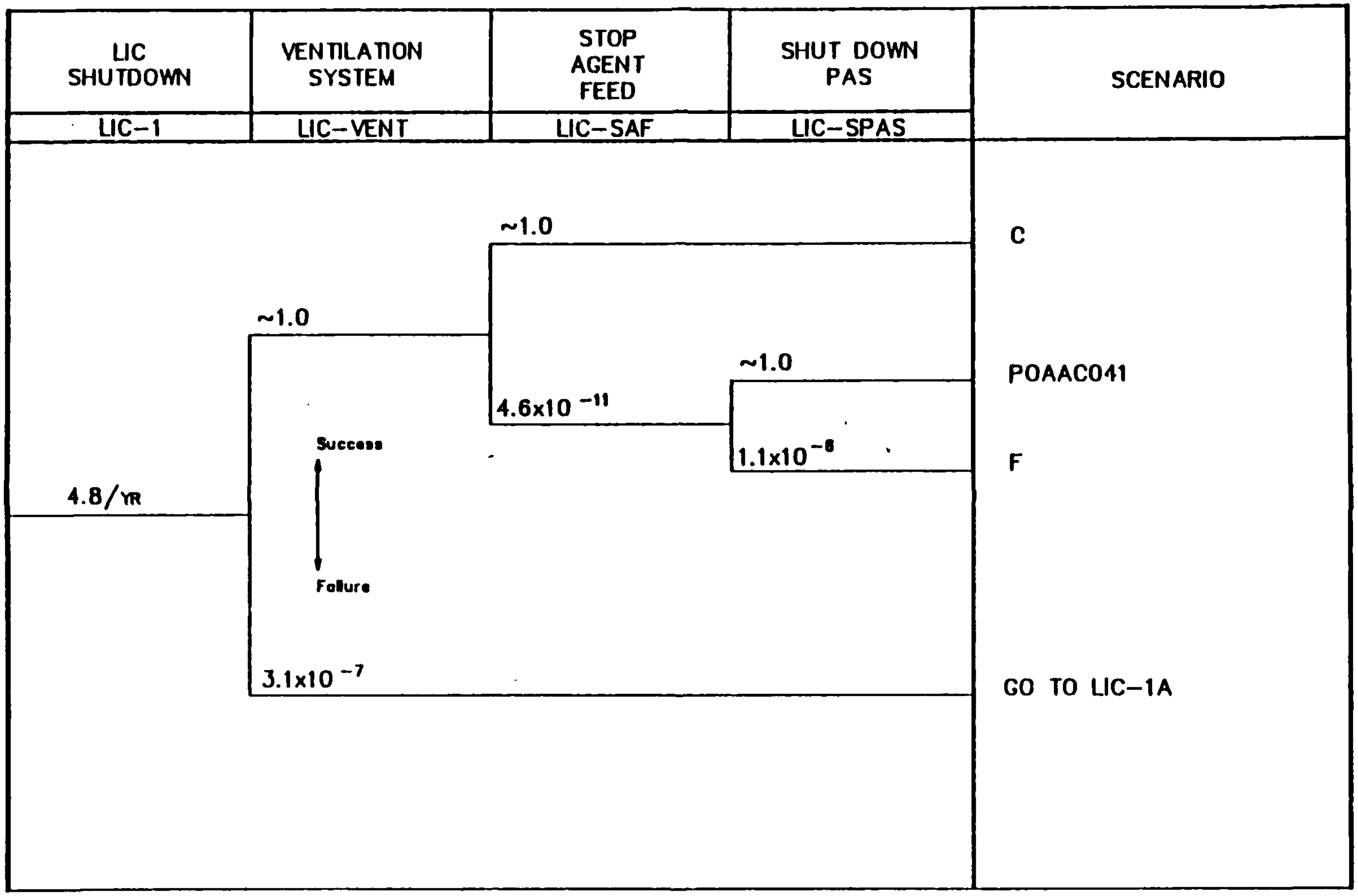


Fig. 7-13. Event tree for LIC-1 initiators

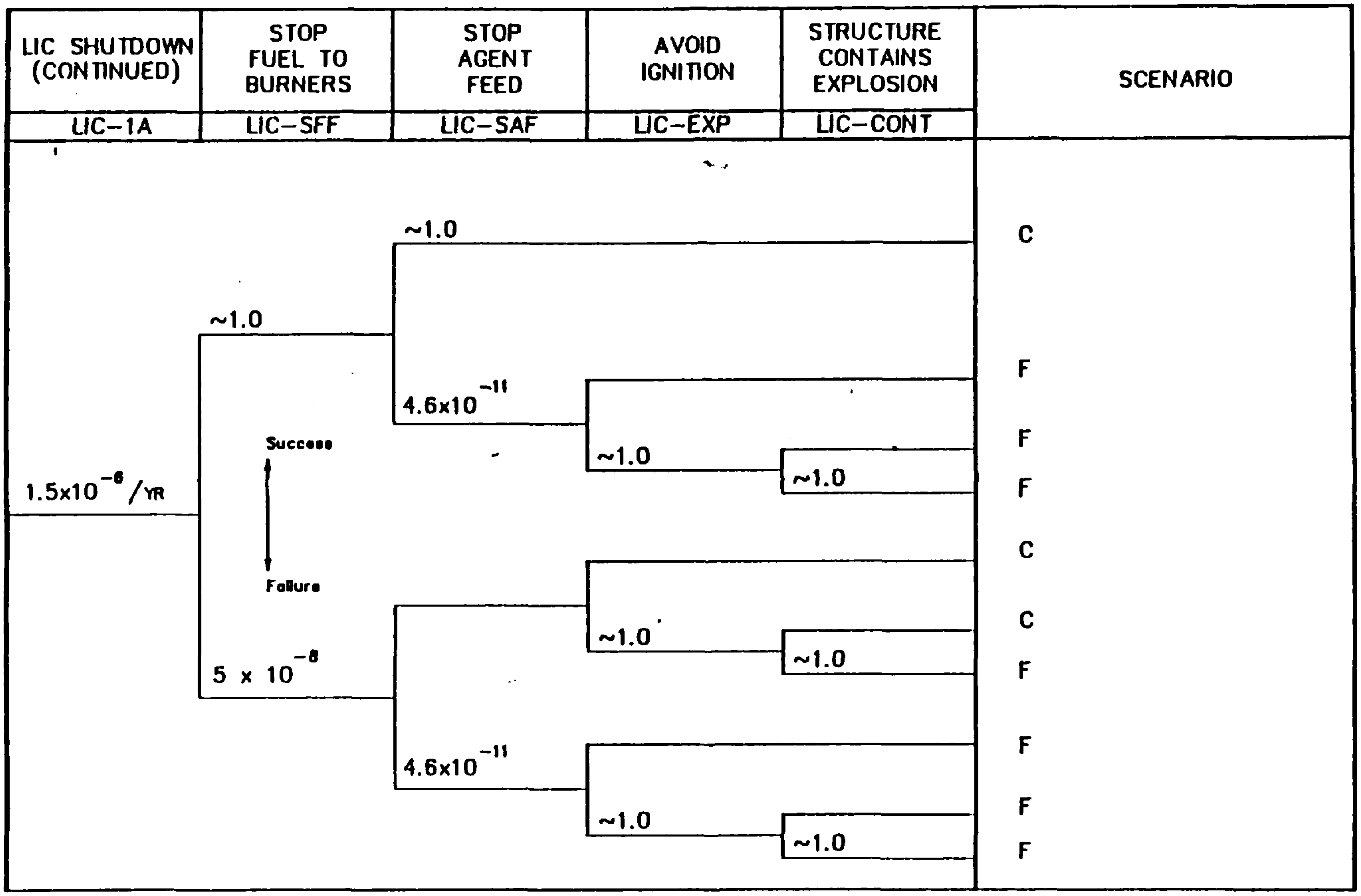


Fig. 7-14. Event tree for LIC-1A initiators

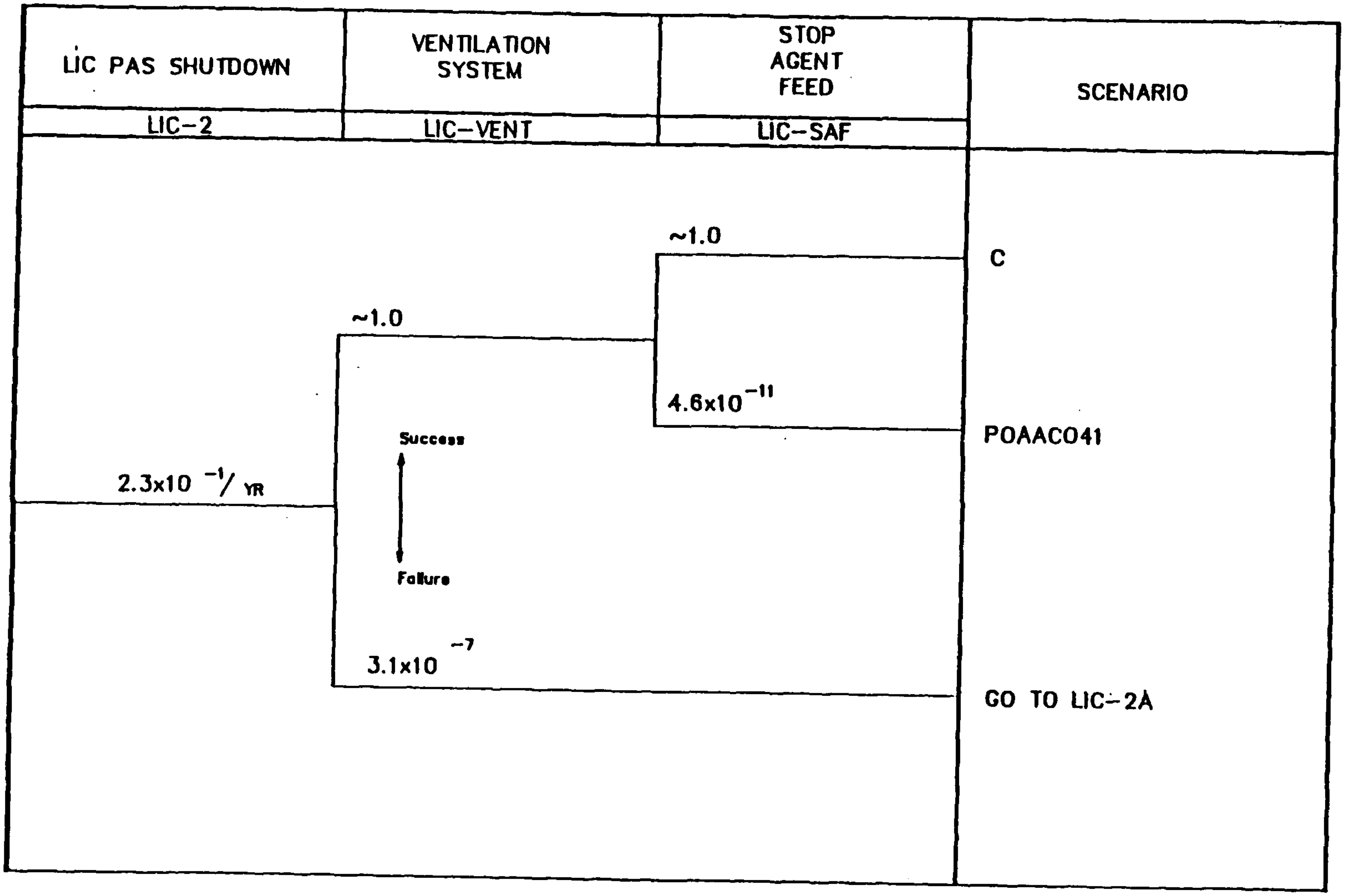


Fig. 7-15. Event tree for LIC-2 initiators

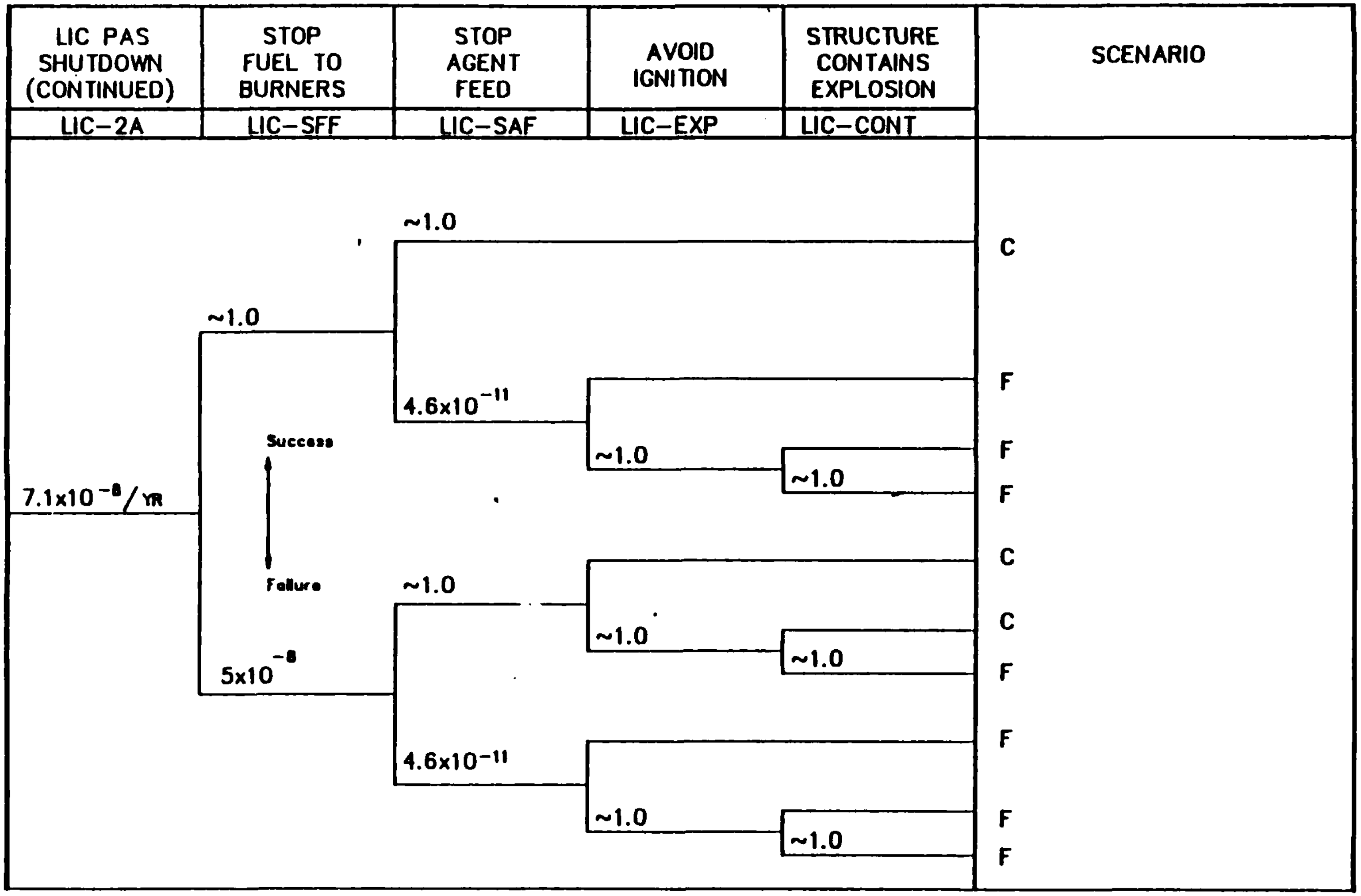


Fig. 7-16. Event tree for LIC-2A initiators

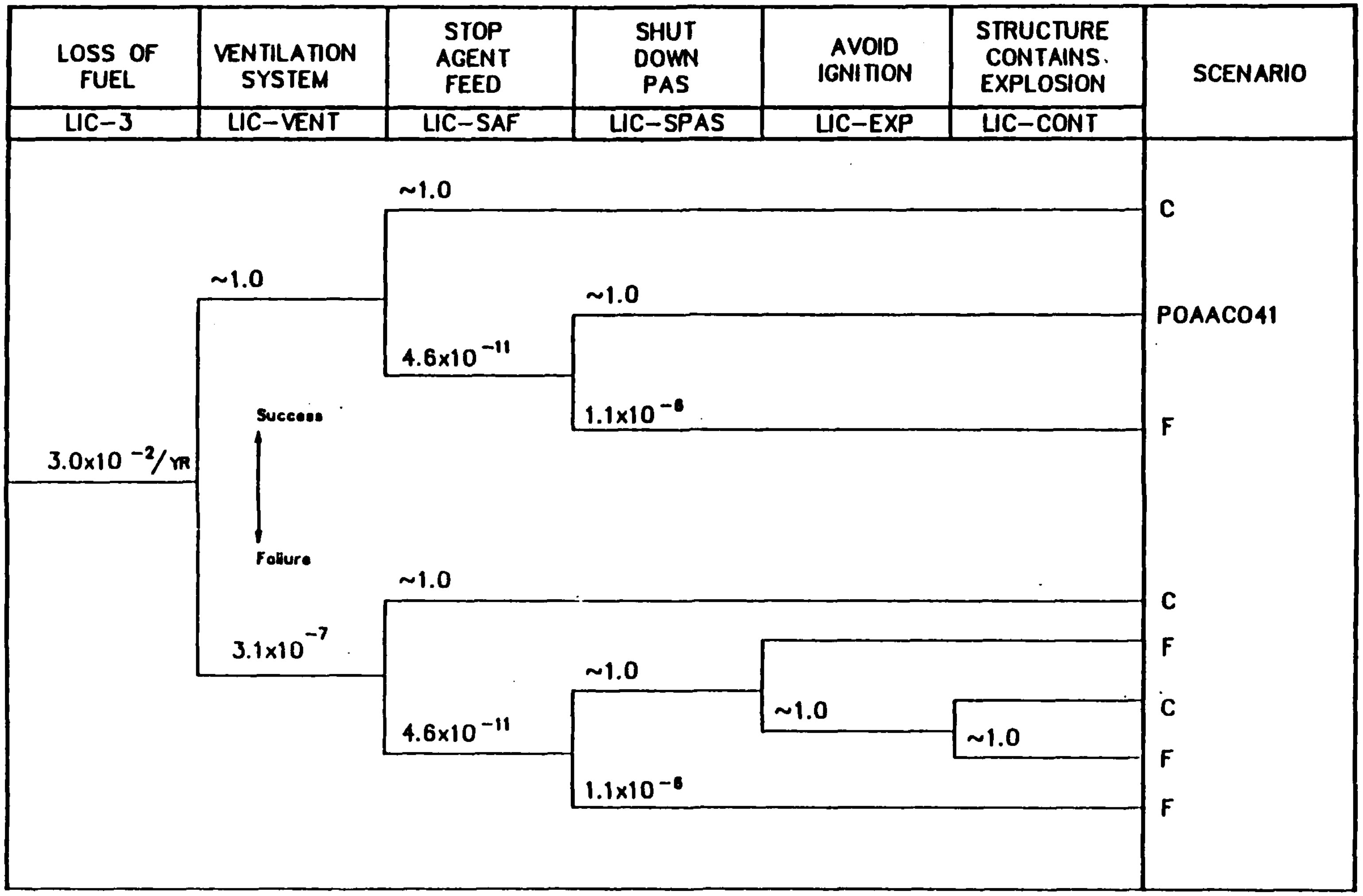


Fig. 7-17. Event tree for LIC-3 initiators

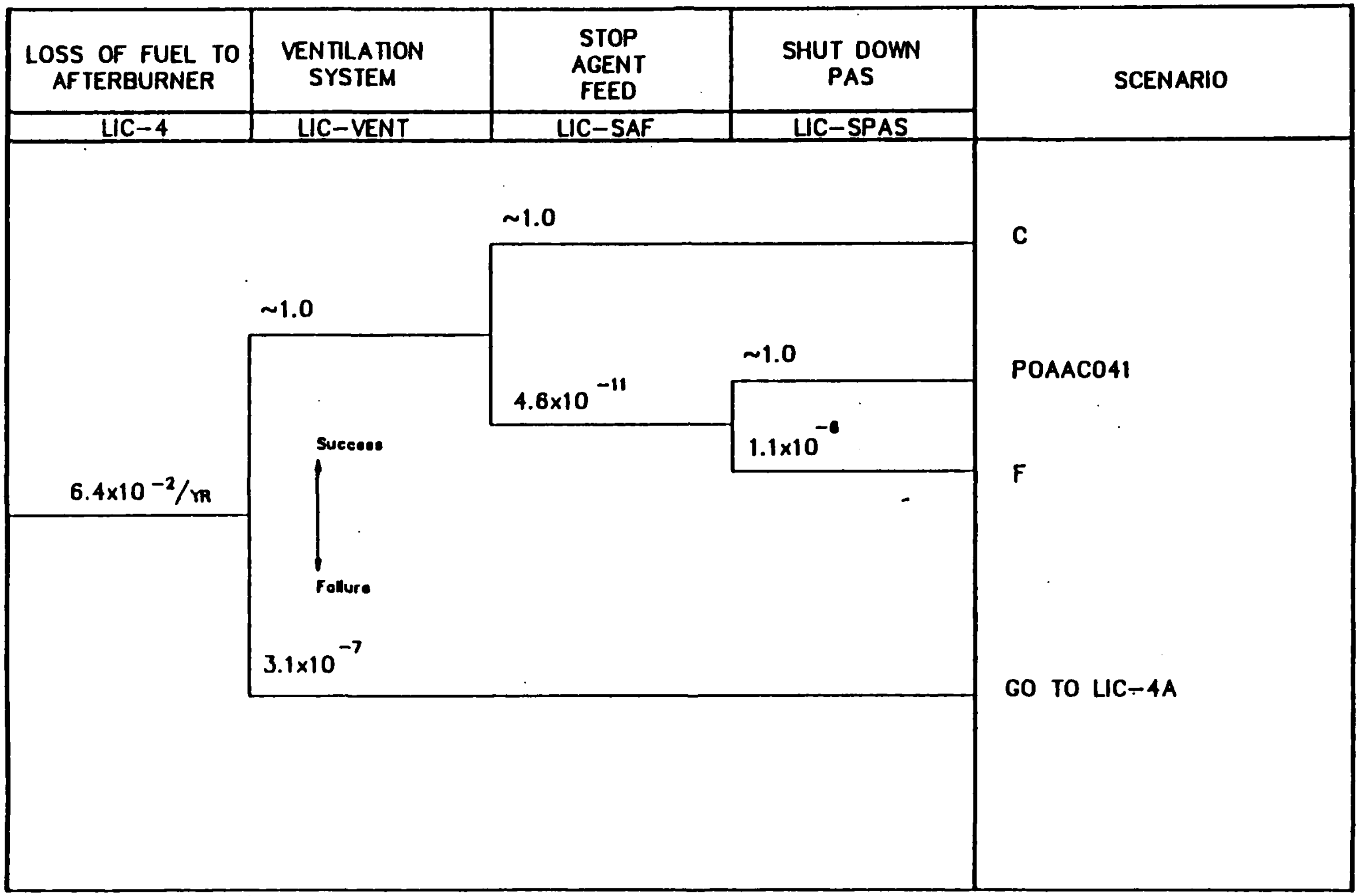


Fig. 7-18. Event tree for LIC-4 initiators

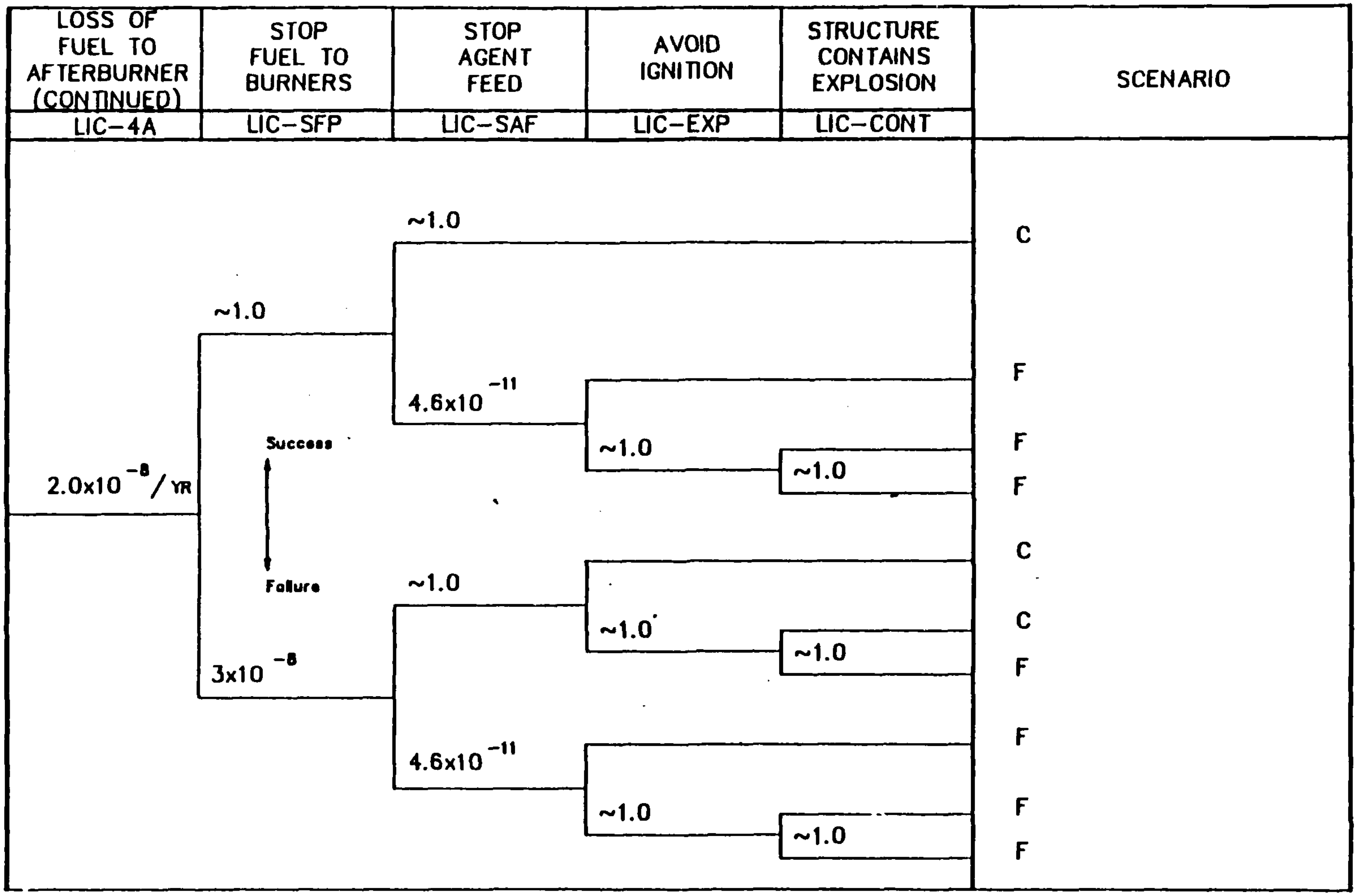


Fig. 7-19. Event tree for LIC-4A initiators

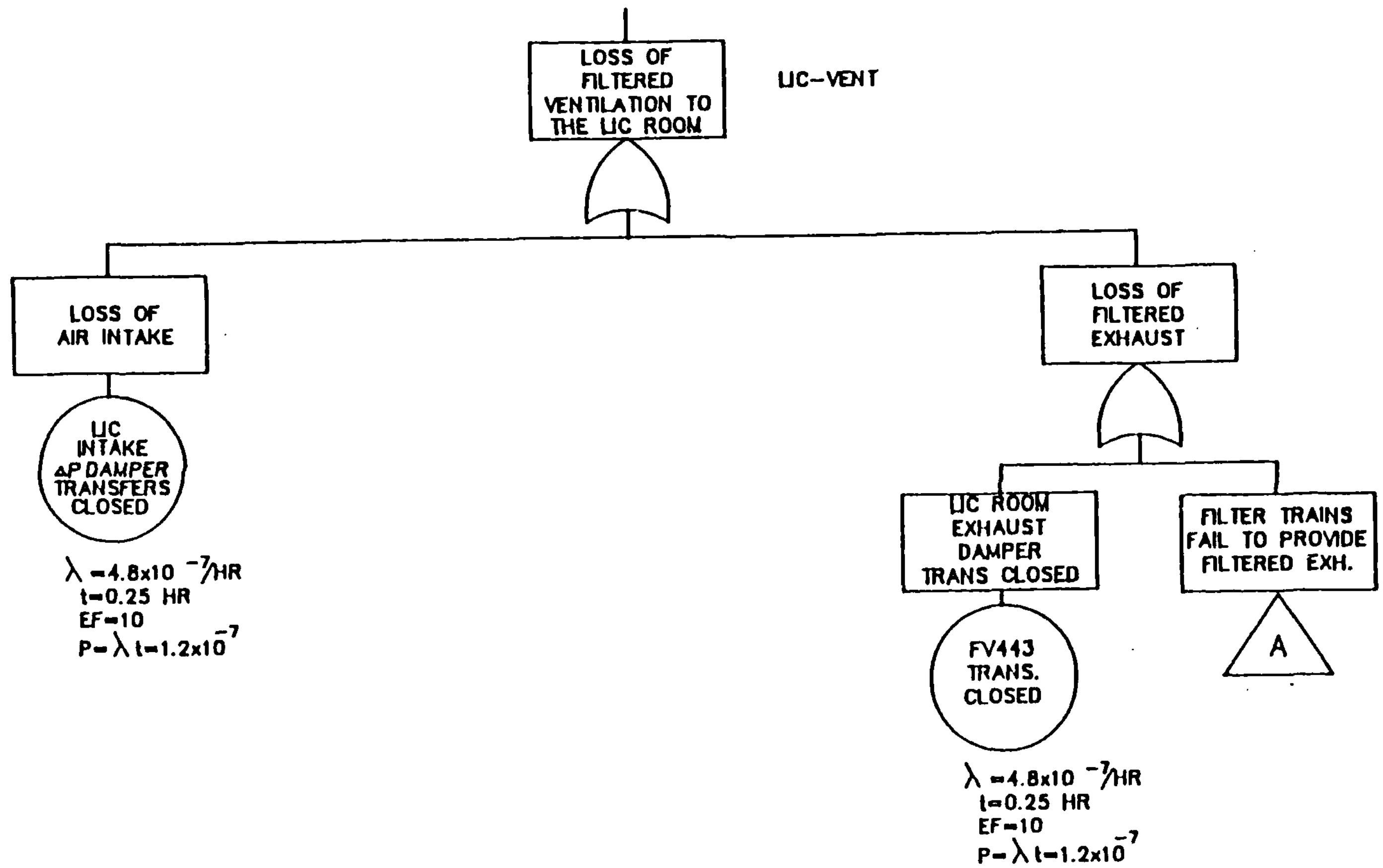


Fig. 7-20. LIC room ventilation fault tree

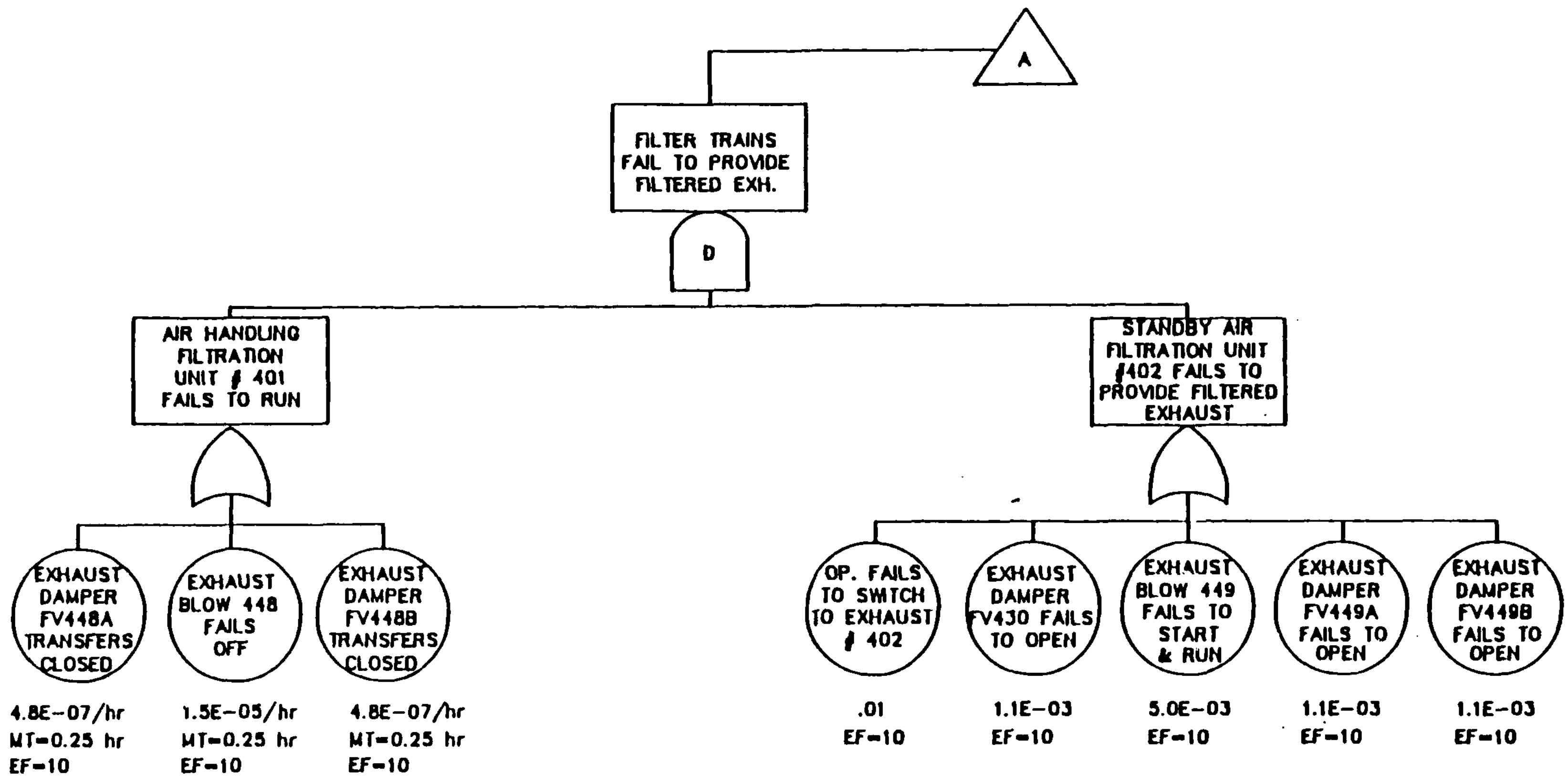


Fig. 7-21. Filtered exhaust fault tree

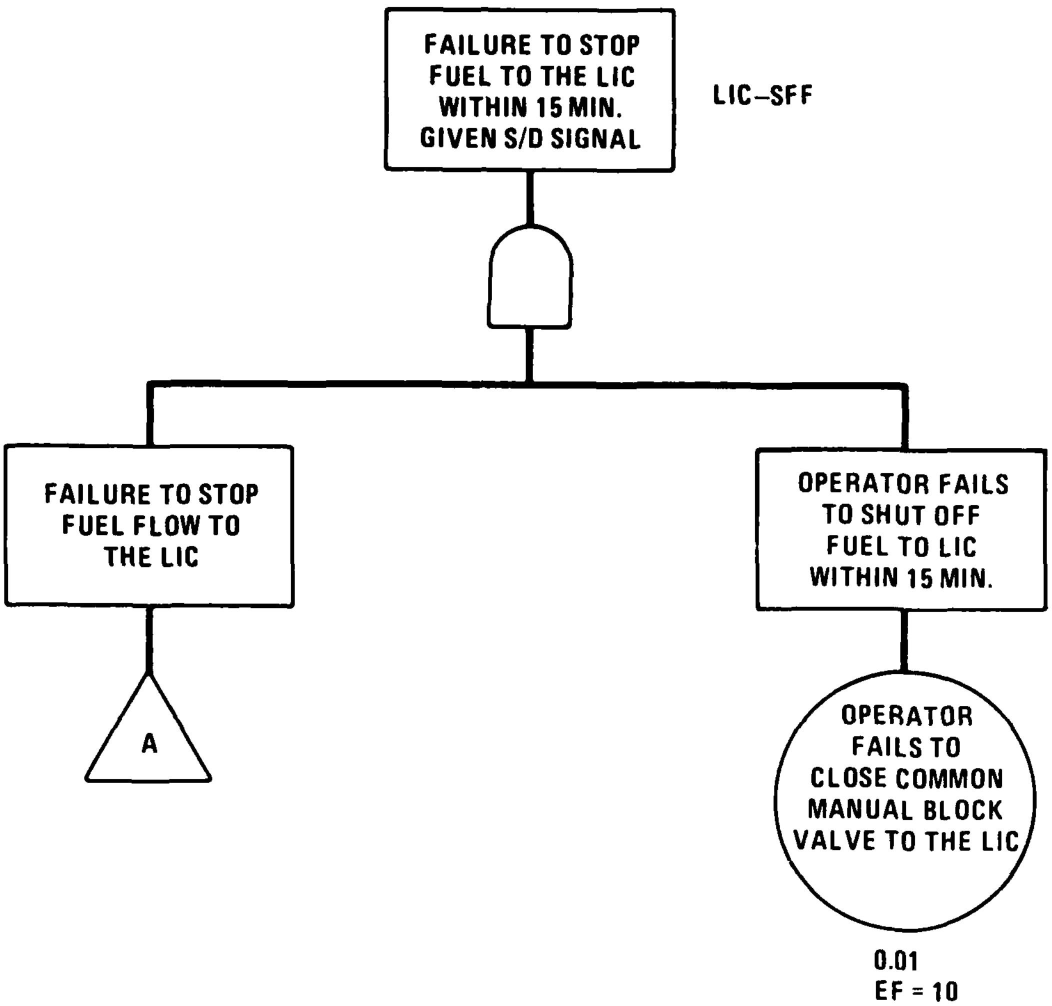


Fig. 7-22. Fault tree for LIC fuel flow termination

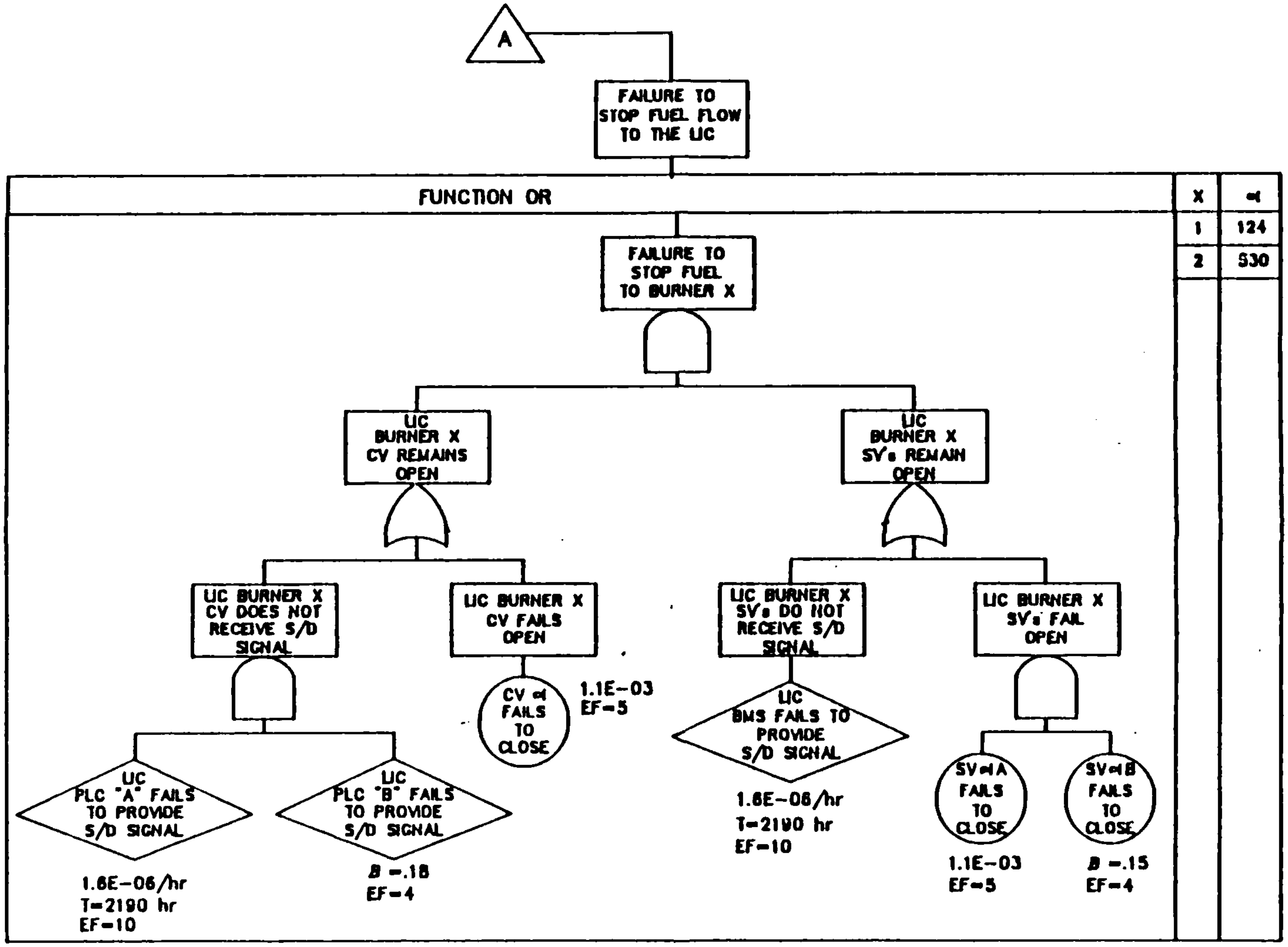


Fig. 7-23. Fault tree for terminating fuel flow to LIC burners

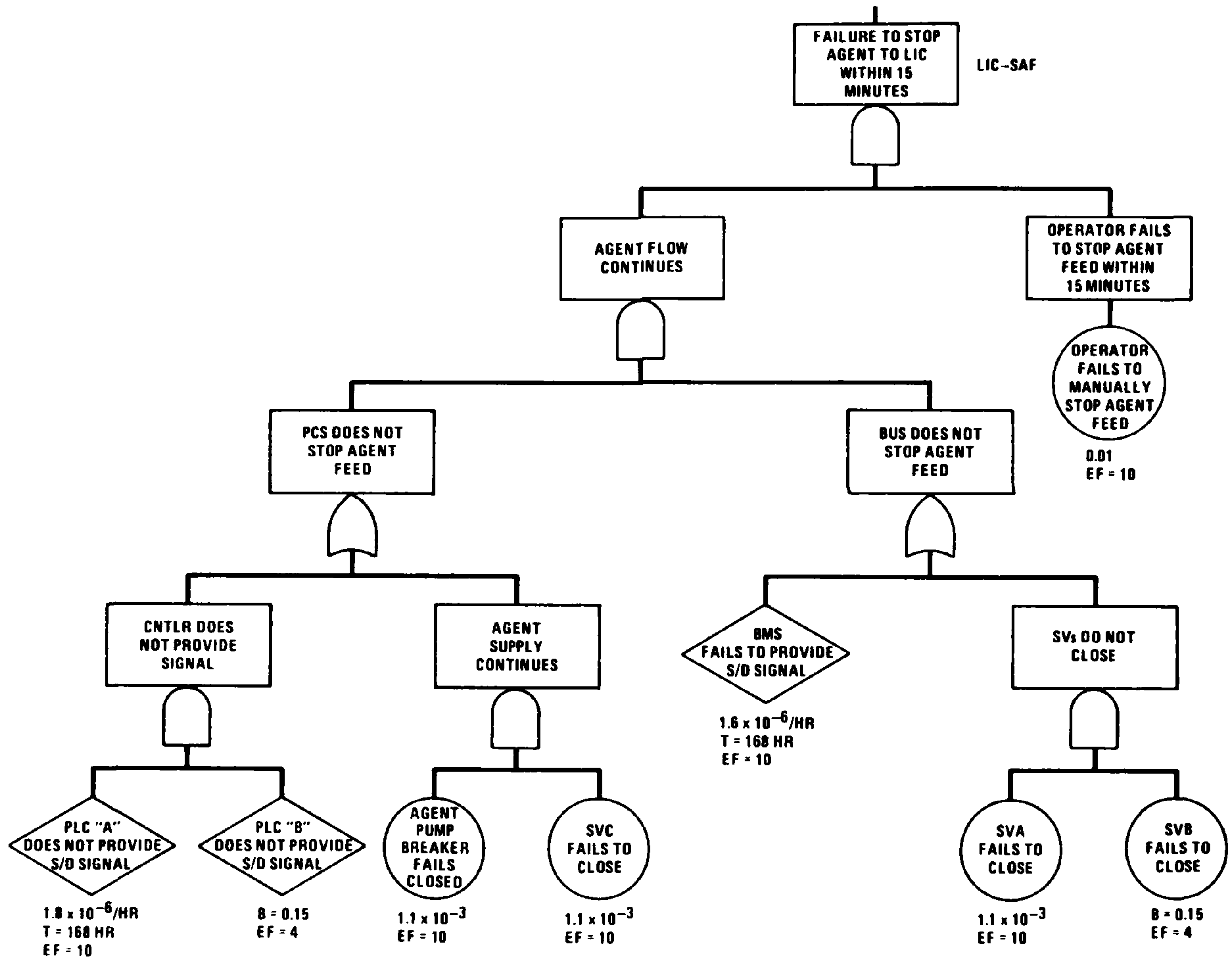


Fig. 7-24. Fault tree for LIC agent feed termination

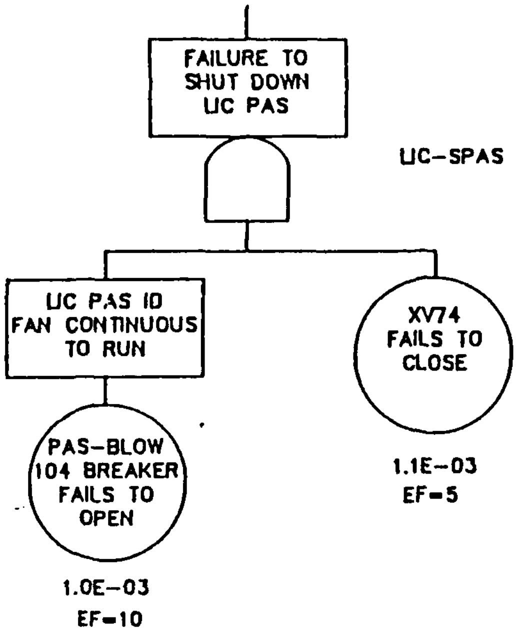


Fig. 7-25. Fault tree for LIC PAS shutdown

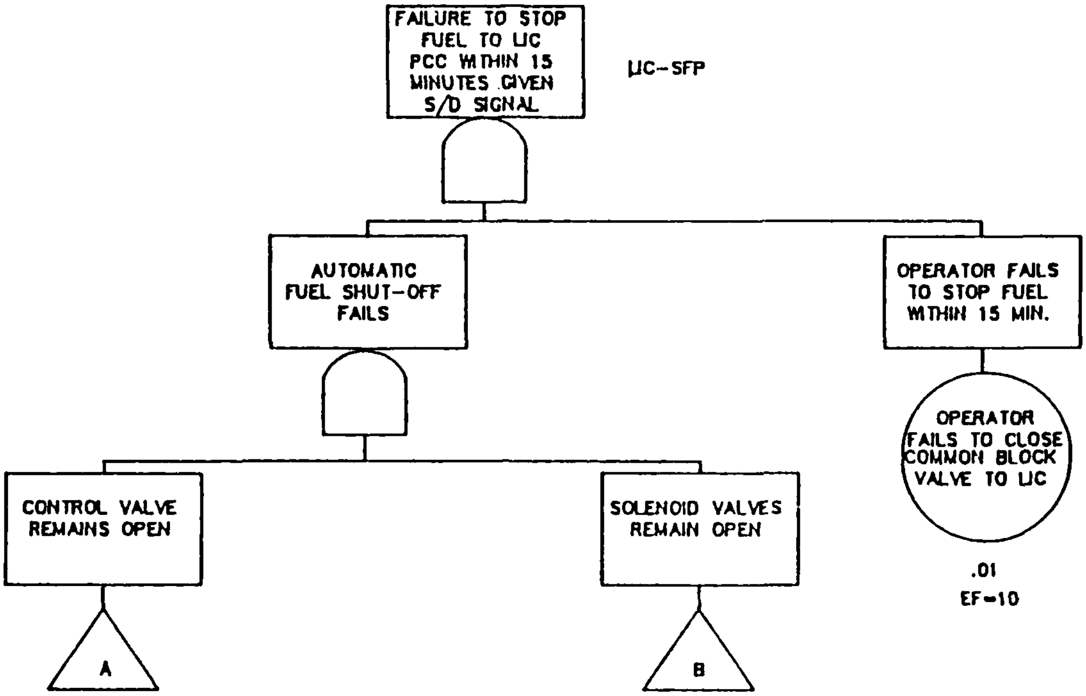


Fig. 7-26. Fault tree for LIC PCC fuel flow termination

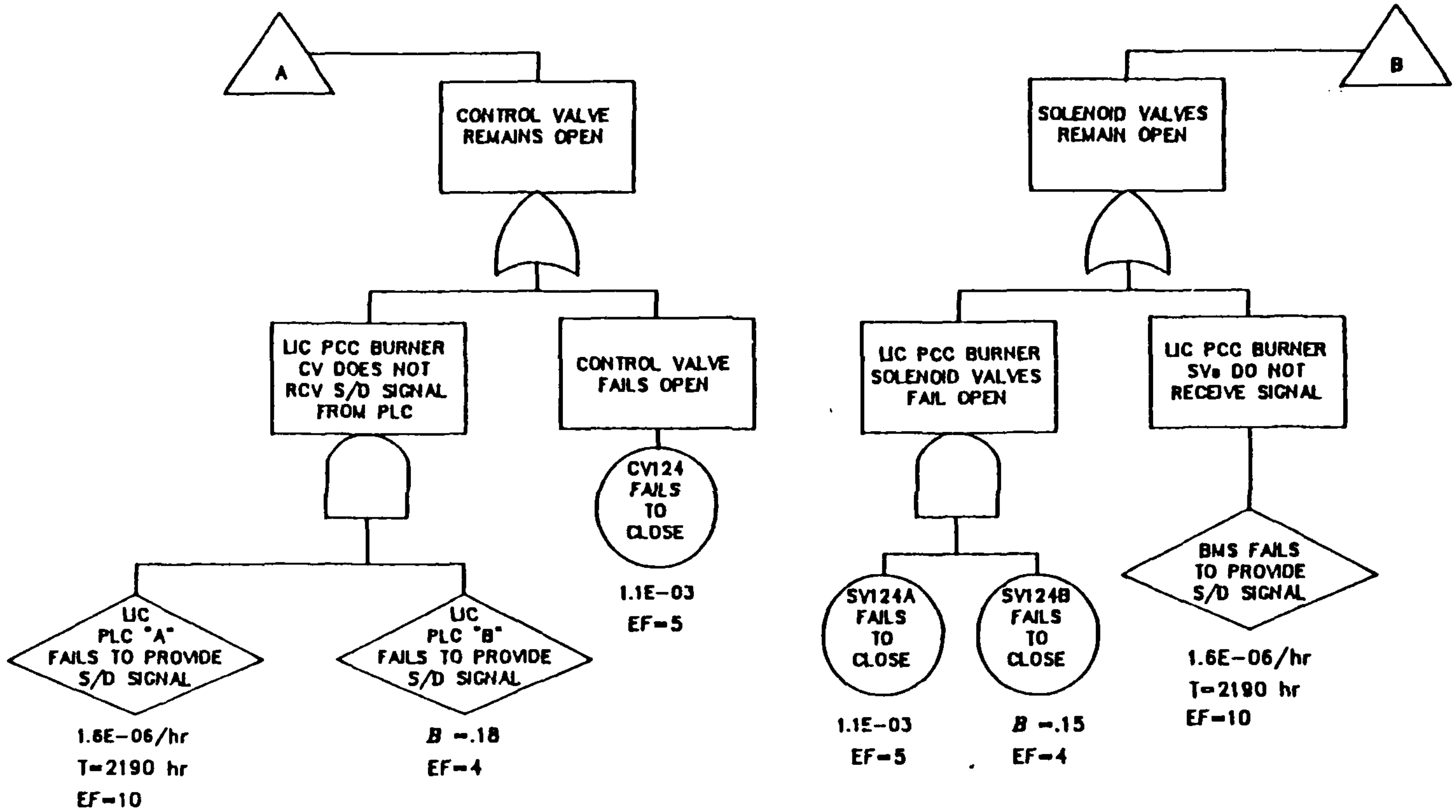


Fig. 7-27. Control and solenoid valve fault trees

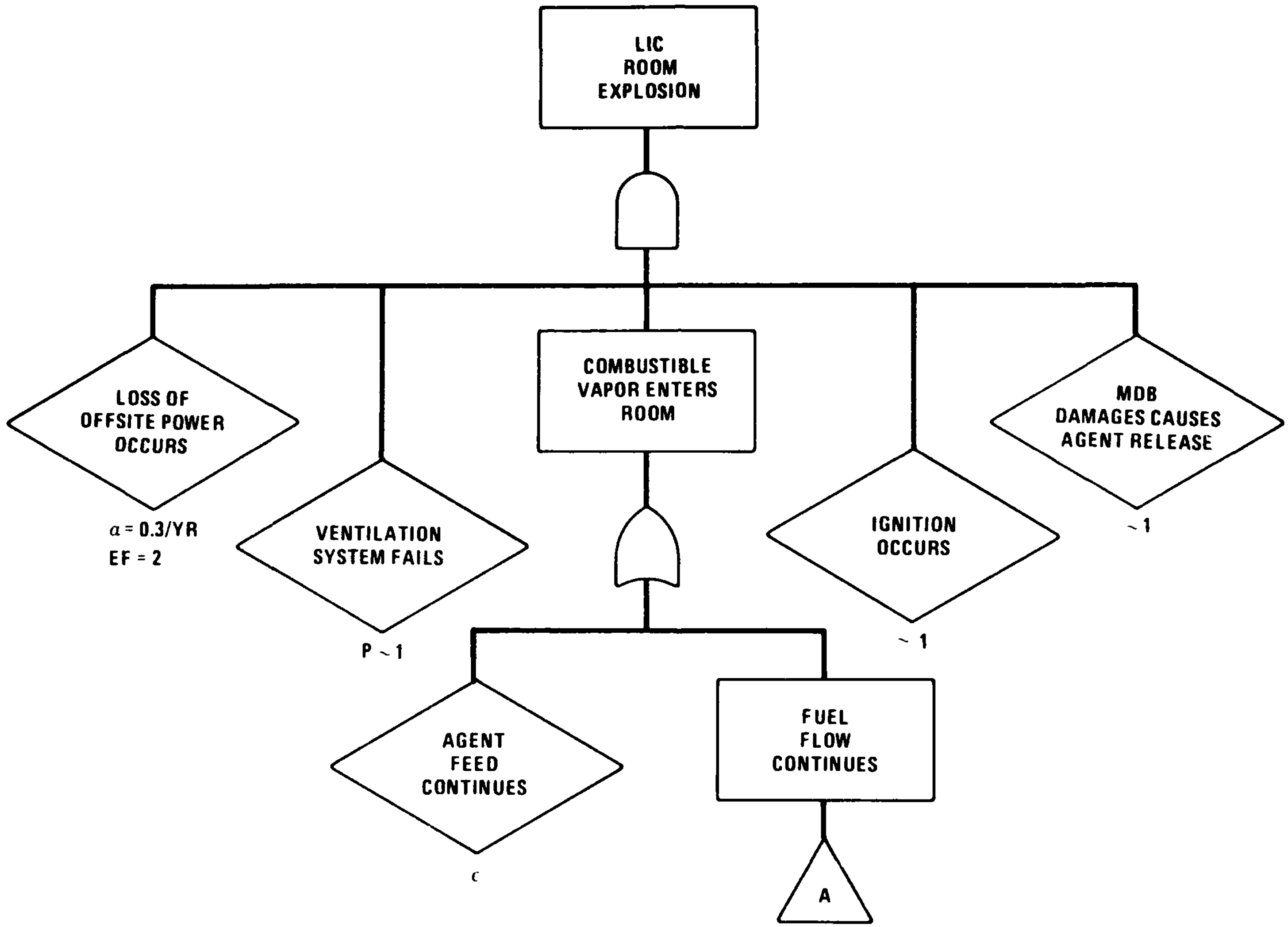


Fig. 7-28. LIC room explosion fault tree

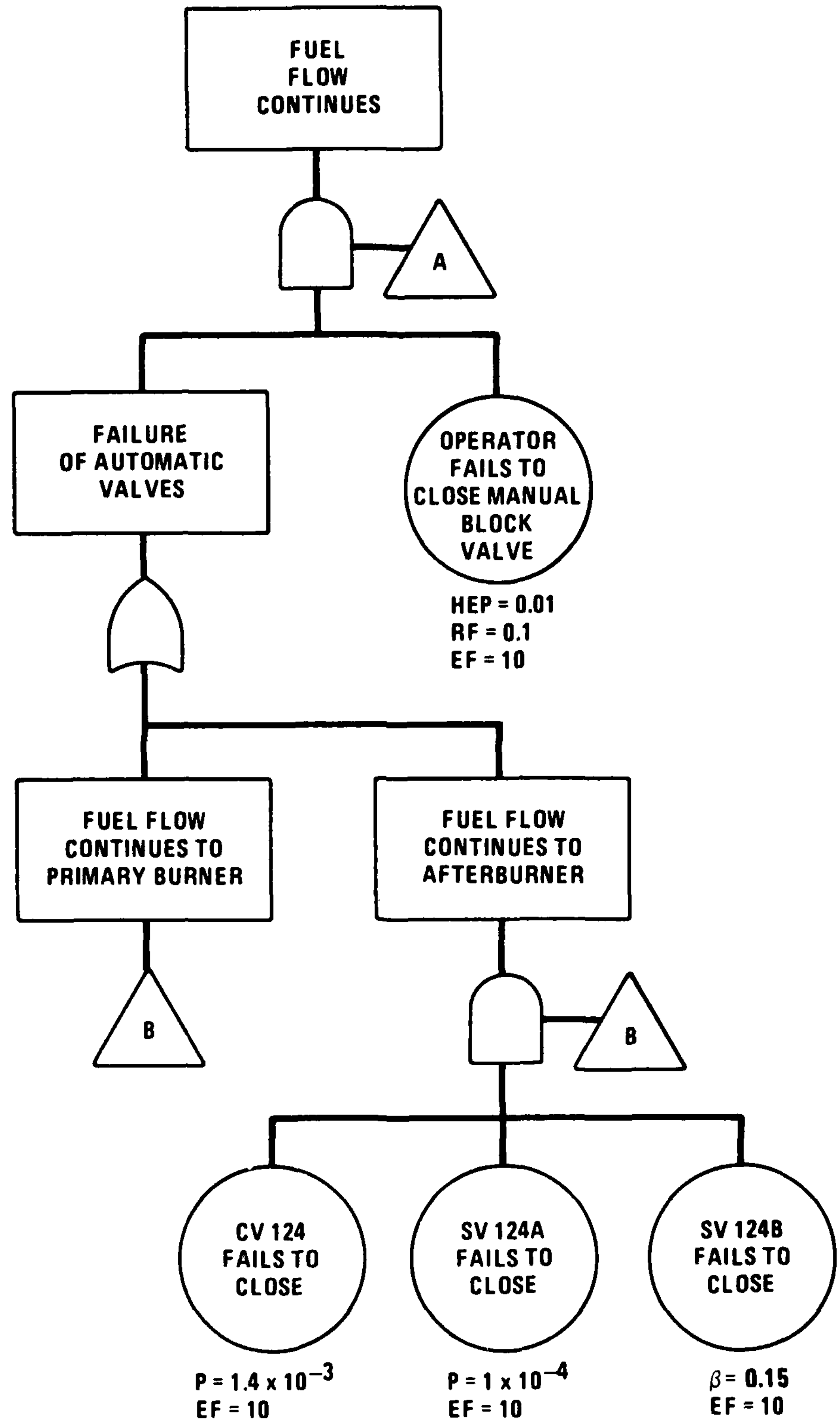


Fig. 7-29. Fault tree for fuel flow forming a flammable mixture in the LIC room

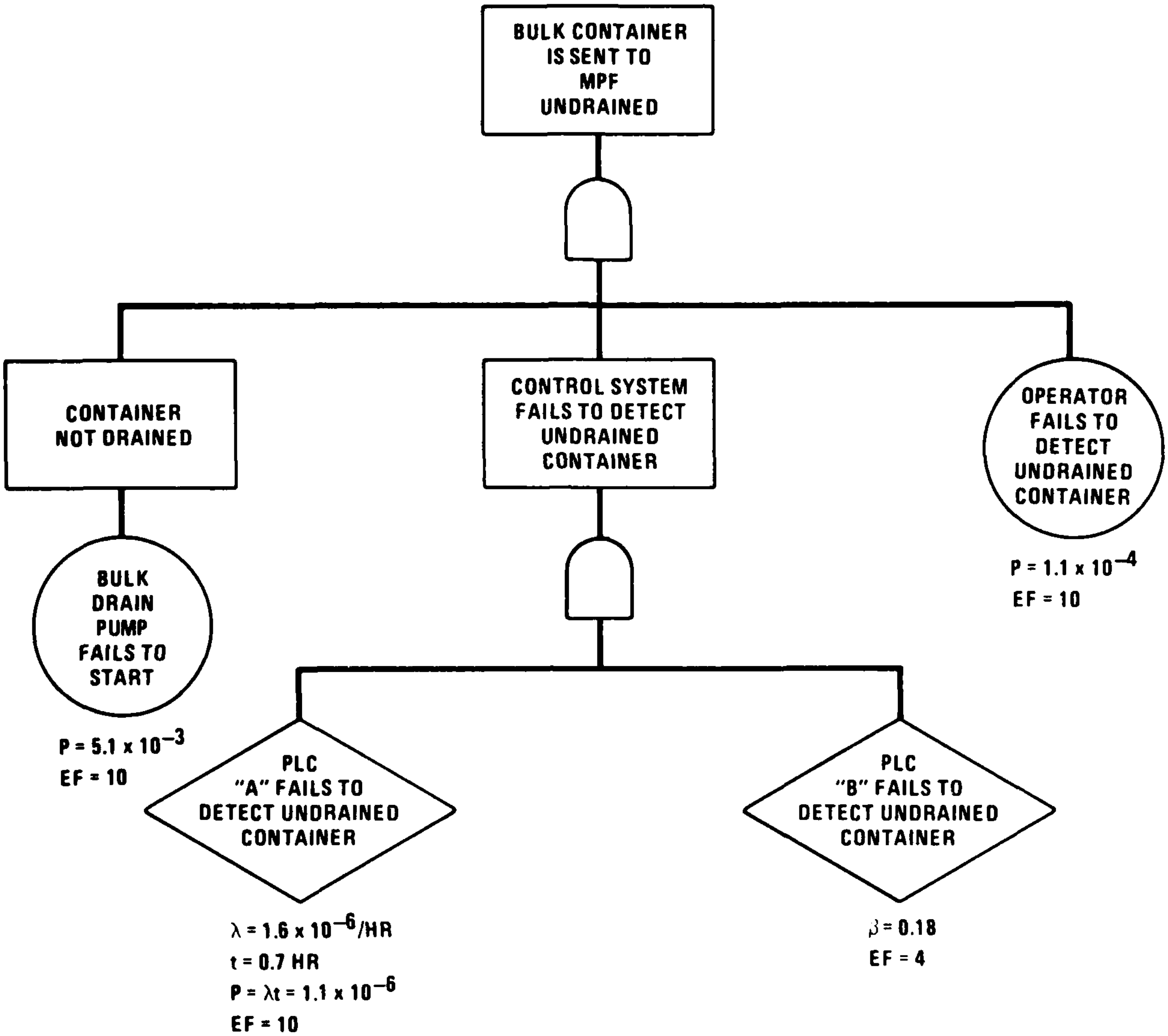


Fig. 7-30. Fault tree for draining bulk containers

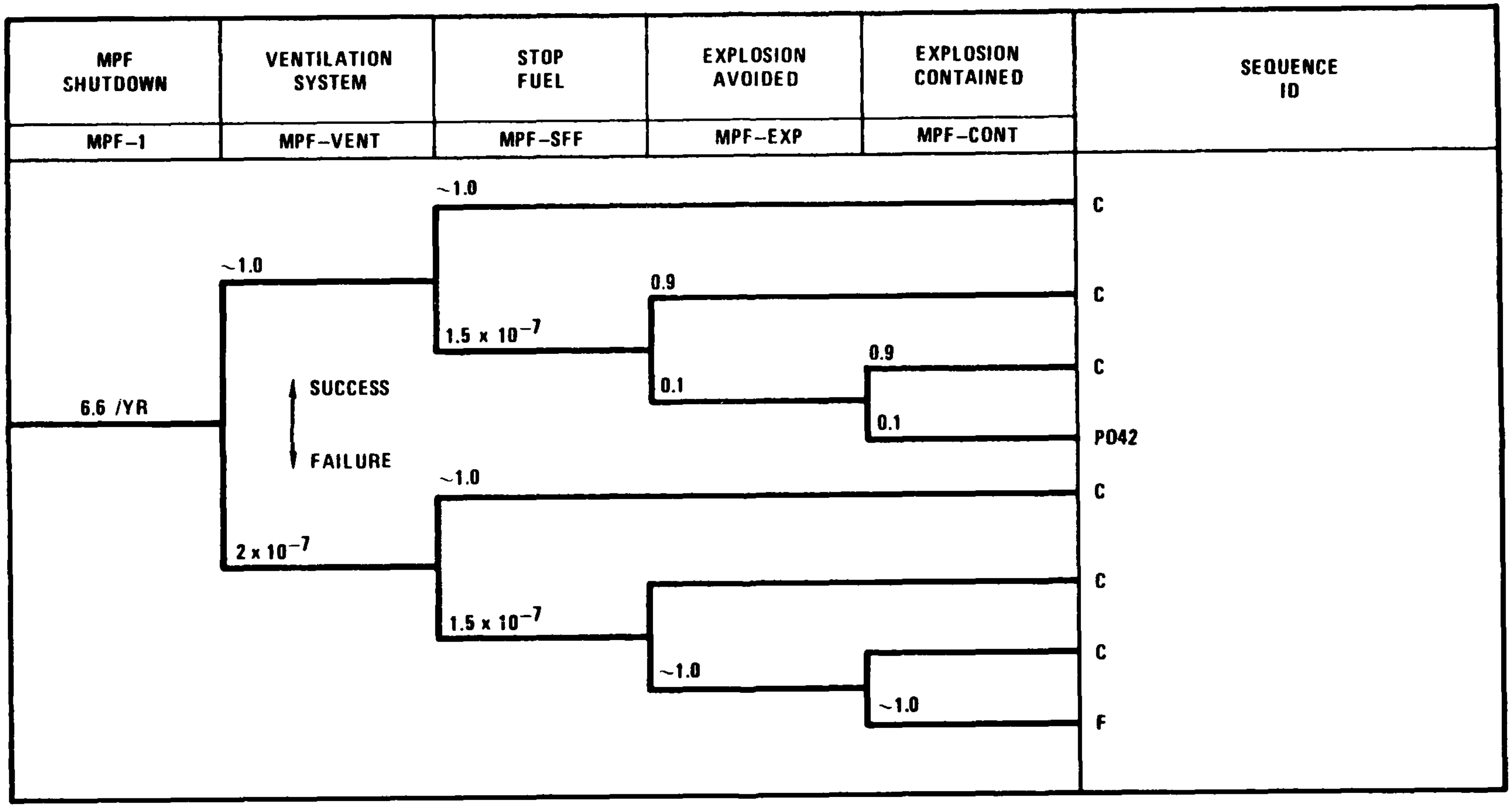


Fig. 7-31. Event tree for MPF shutdown

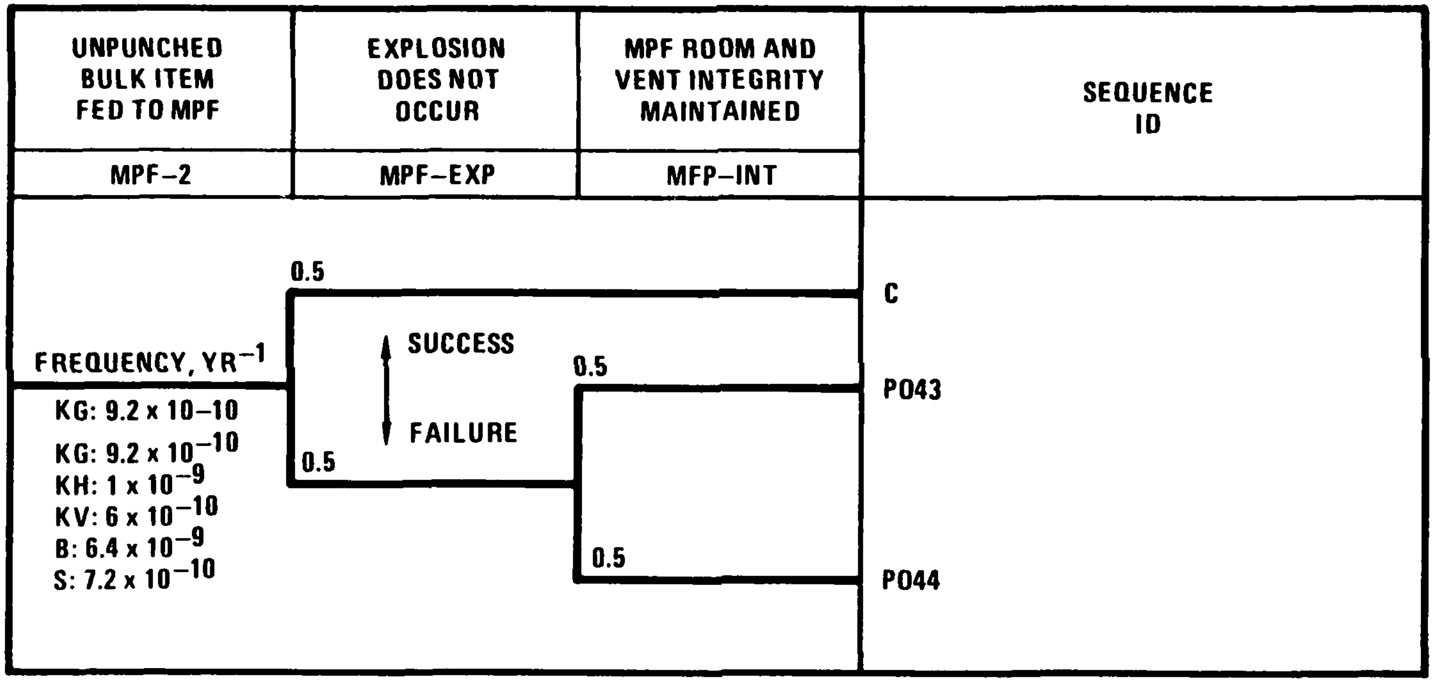


Fig. 7-32. Event tree for unpunched bulk item fed to MPF

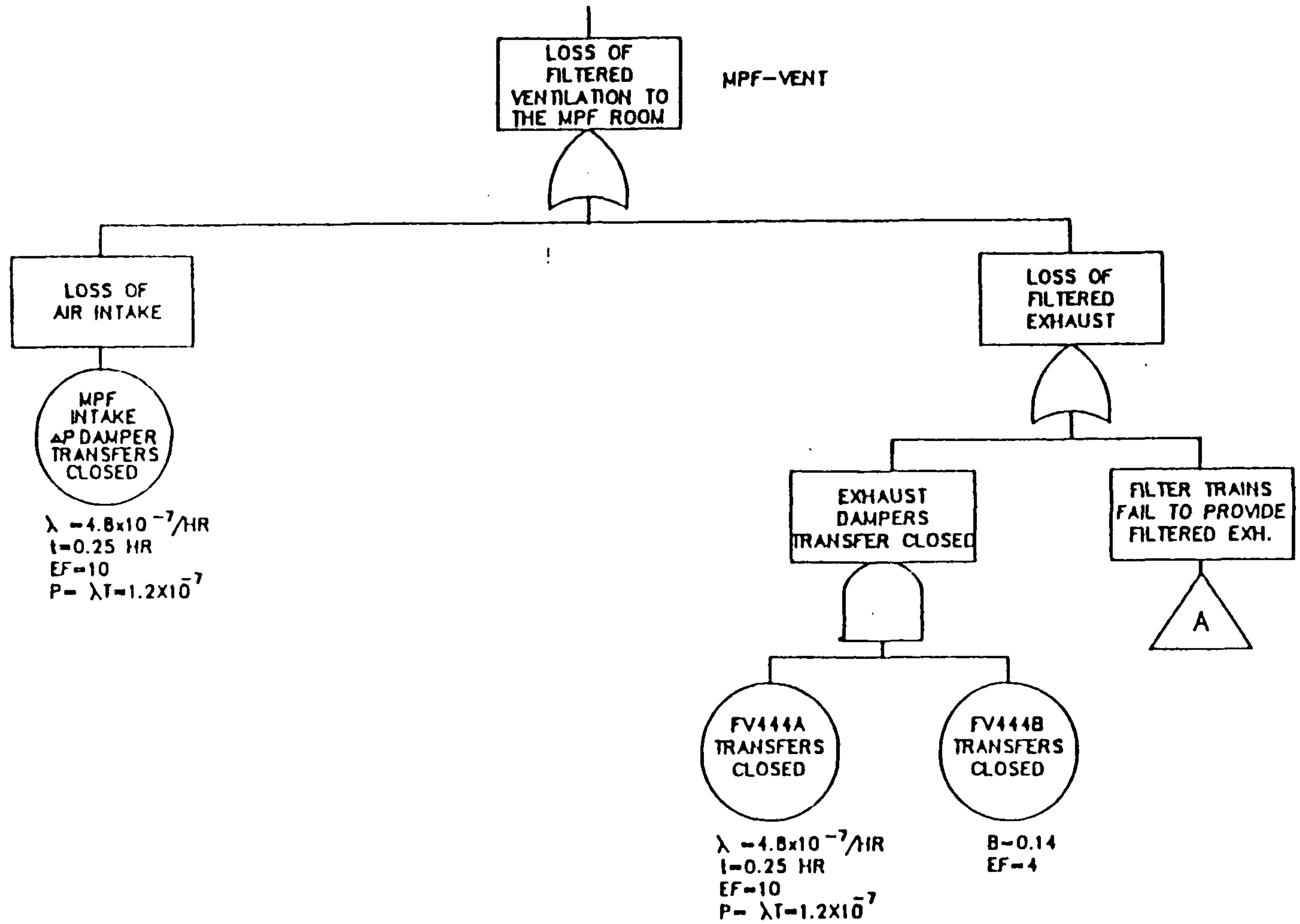


Fig. 7-33. MPF room ventilation fault tree

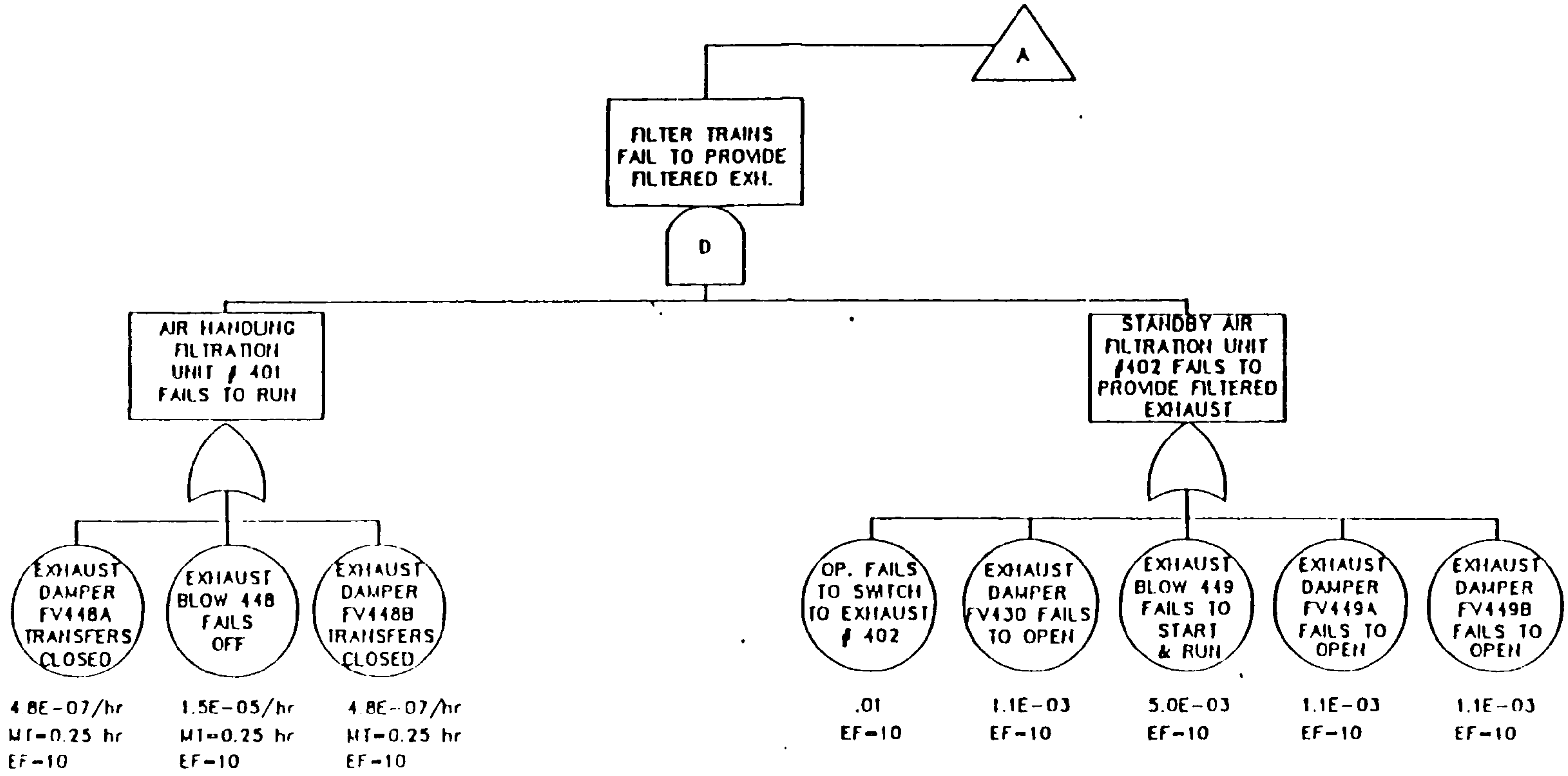


Fig. 7-34. MPF room filtered exhaust fault tree

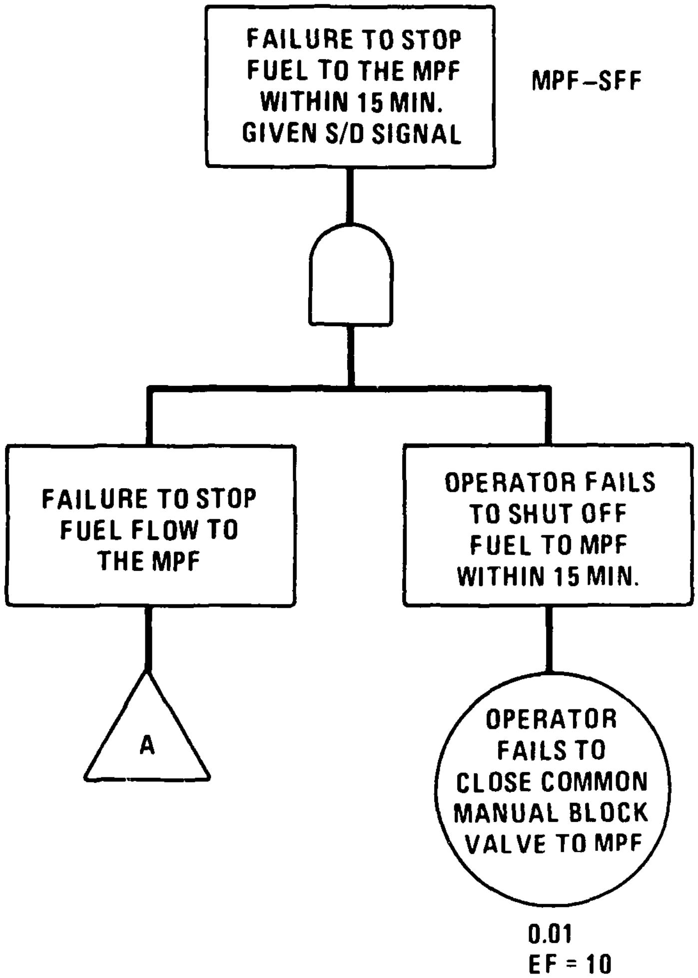
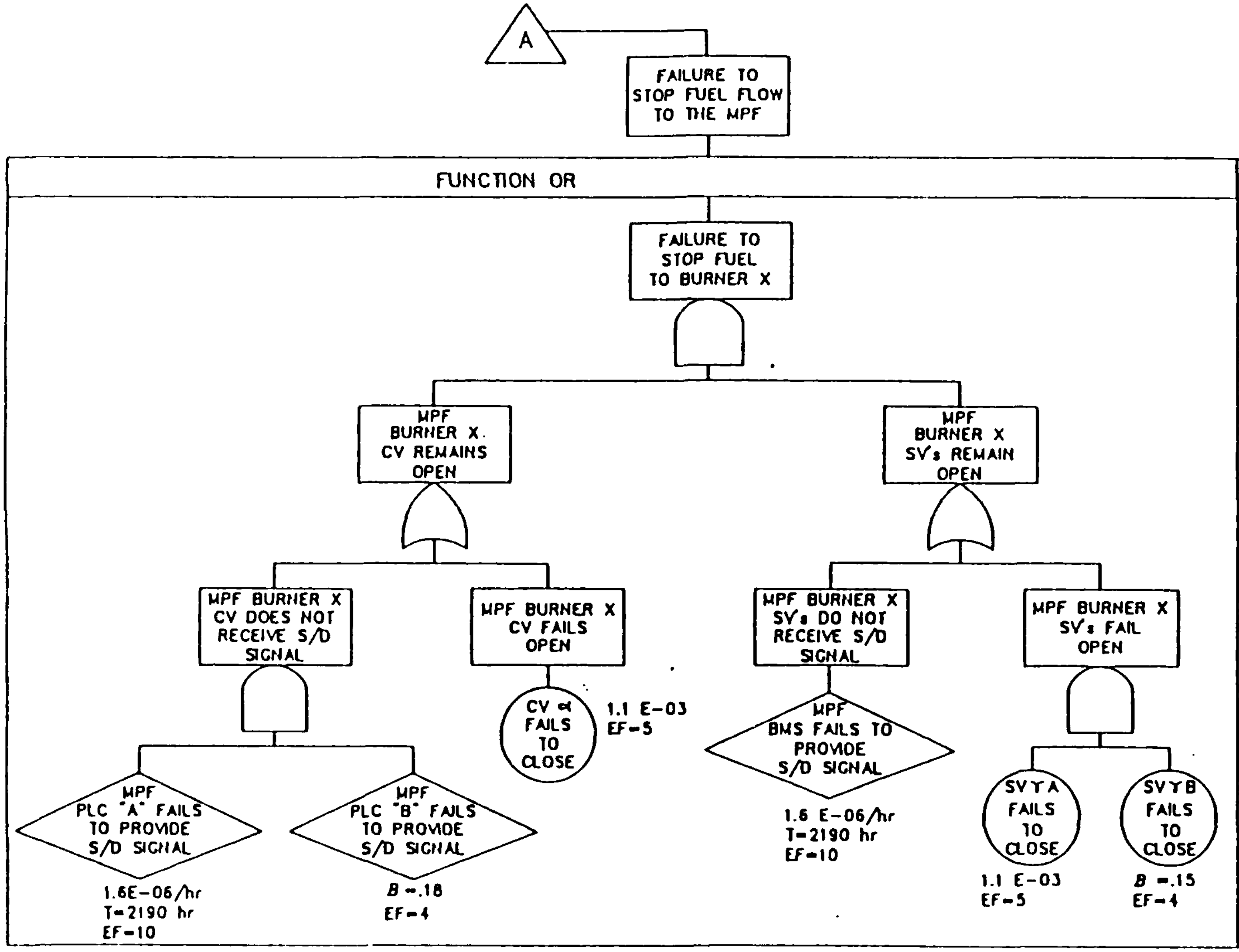


Fig. 7-35. Fault tree for MPF fuel flow termination



X	α	γ
1	166	167
2	186	187
3	206	207
4	226	227
5	246	247
6	266	267
7	46	47
8	67	68
9	106	107
10	126	127

Fig. 7-36. Fault tree for failure to stop fuel to MPF burners

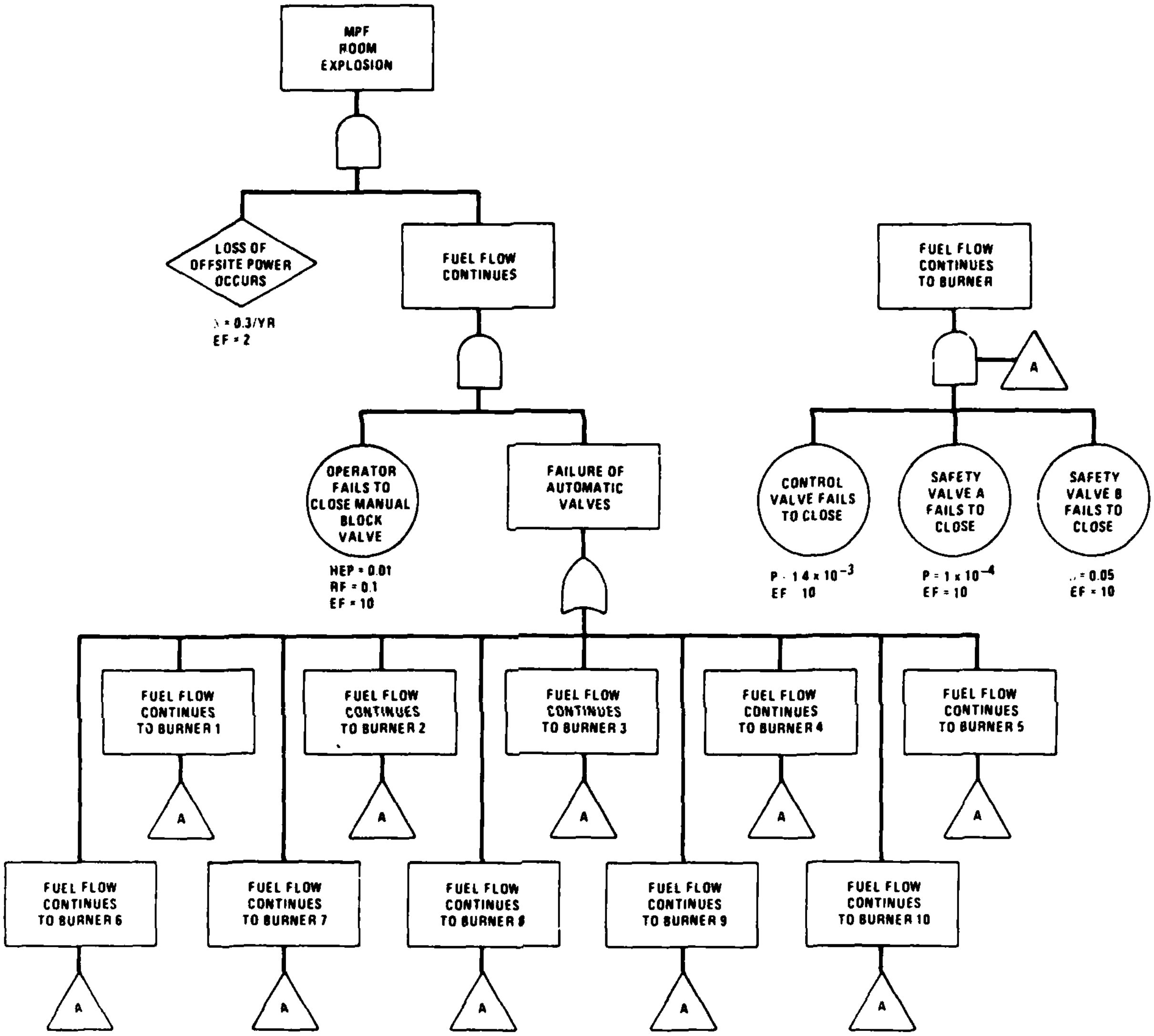


Fig. 7-37. MPF room explosion fault tree (loss of offsite power)

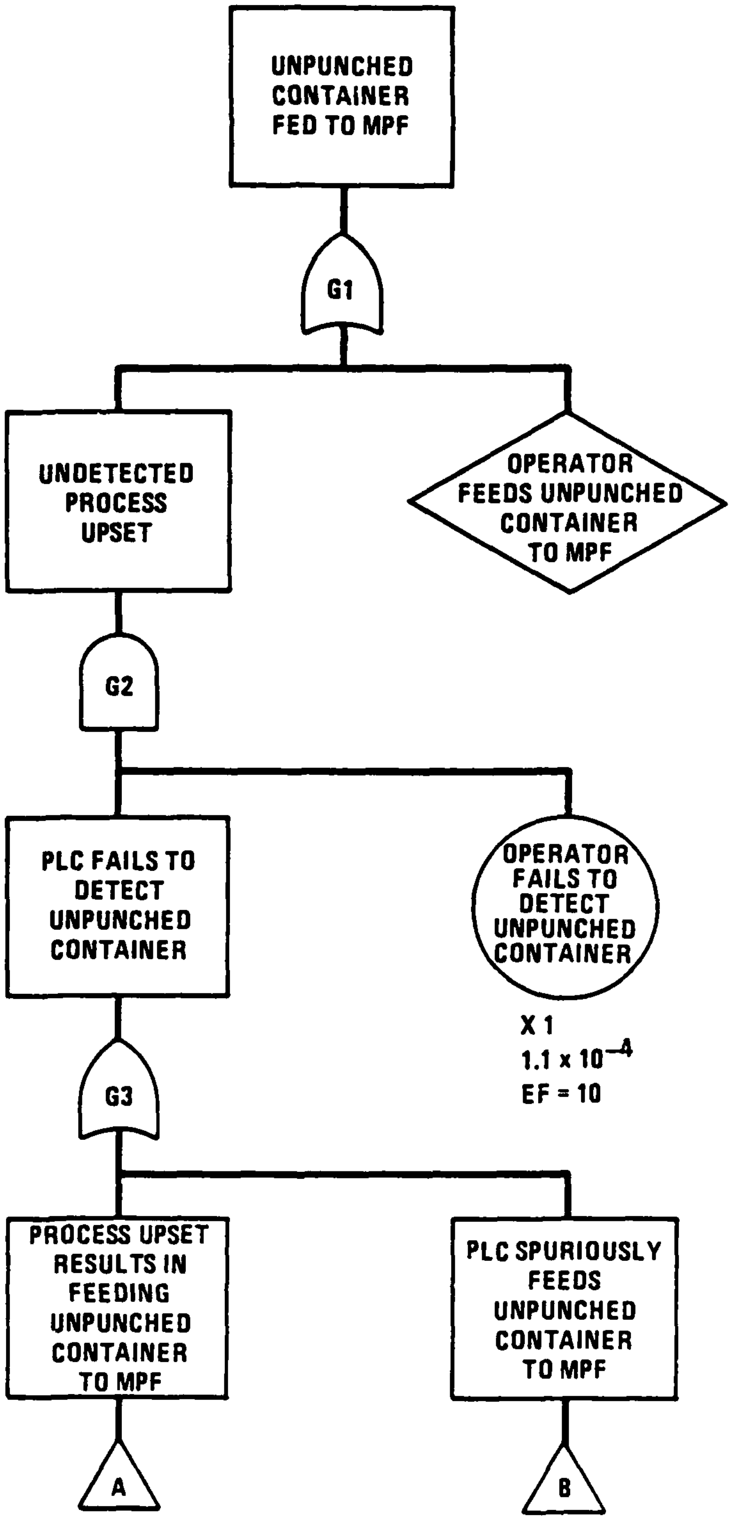


Fig. 7-38. Fault tree for feeding an unpunched container to the MPF (sheet 1 of 4)

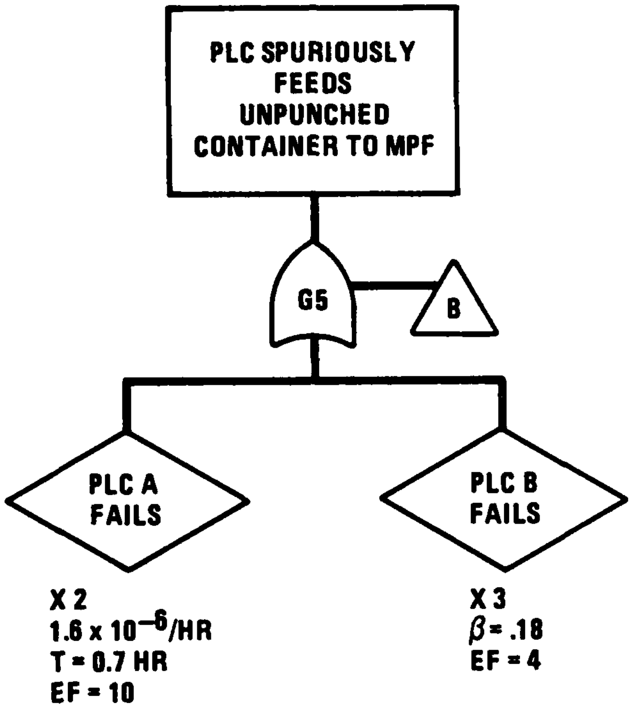


Fig. 7-38. Fault tree for feeding an unpunched container to the MPF (sheet 2 of 4)

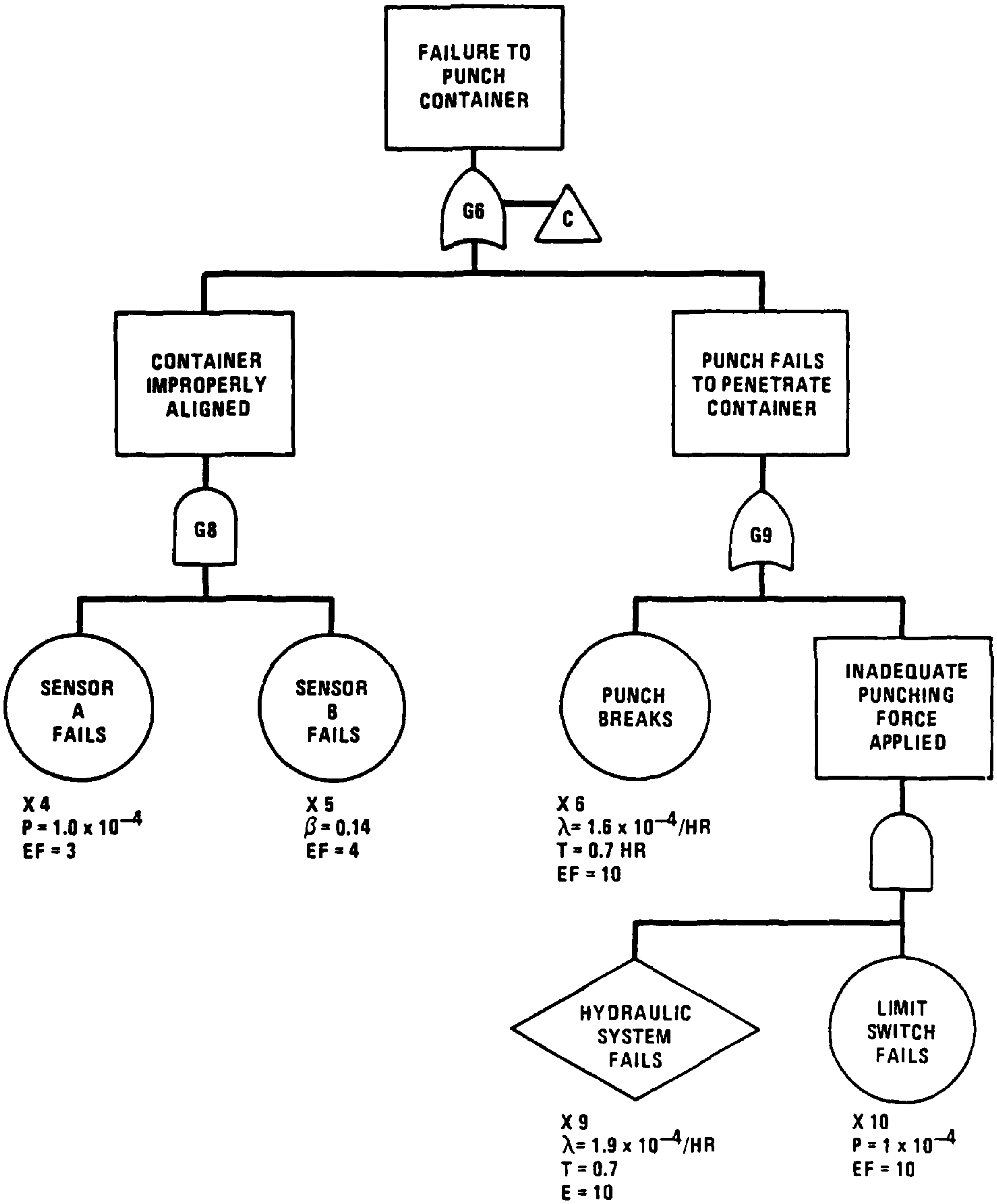


Fig. 7-38. Fault tree for feeding an unpunched container to the MPF (sheet 3 of 4)

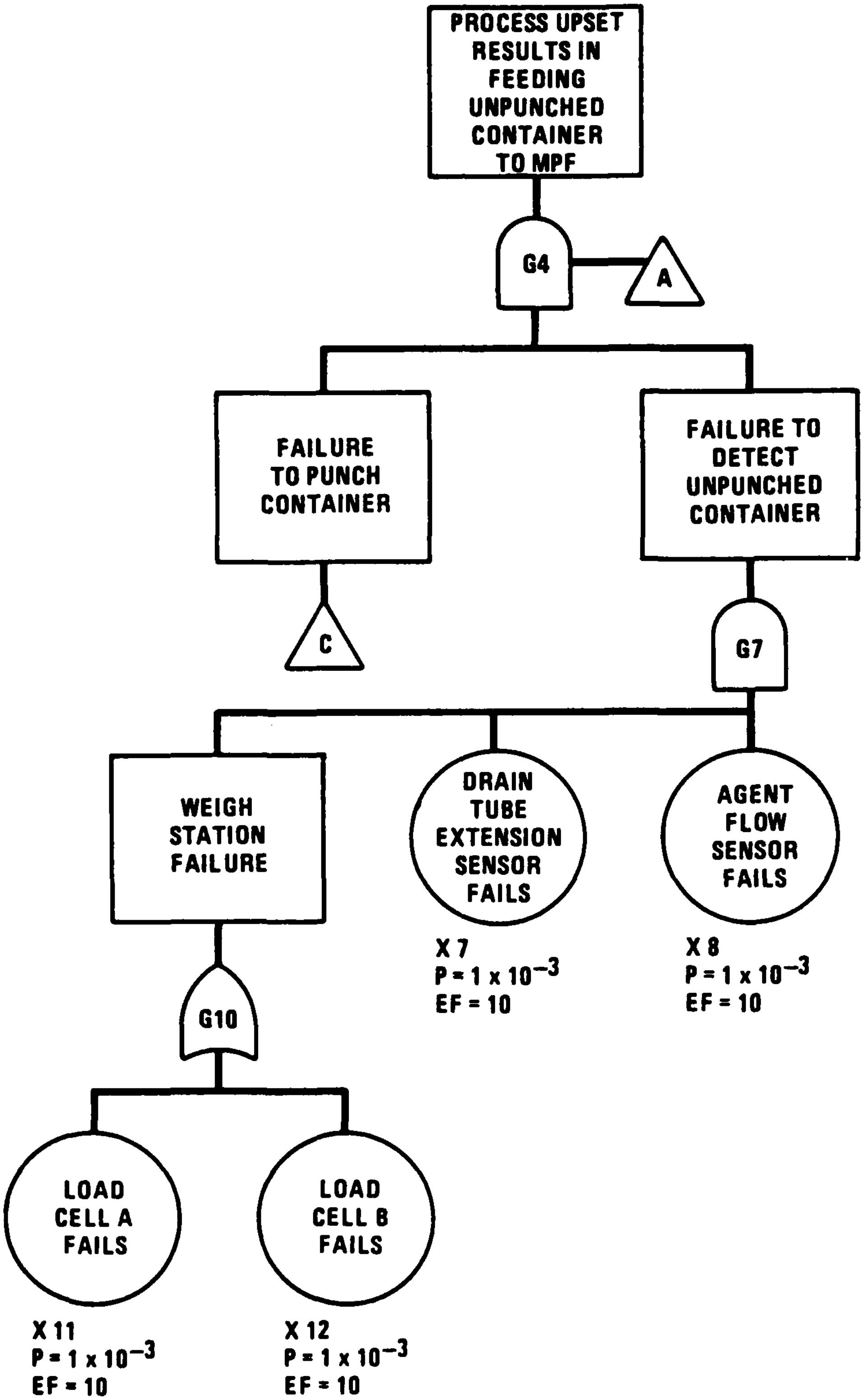


Fig. 7-38. Fault tree for feeding an unpunched container to the MPF (sheet 4 of 4)

The probability that the operators mistakenly leave a mine in the dunnage box involves two operator errors, one of which is recoverable. First, an operator must inadvertently begin to place a mine in the dunnage box. This human error is estimated to have the probability of 0.01. However, the mine weighs 23 lb, and is of a different shape than the drum packing material. Since the extra weight and shape difference are sensory cues to alert the operator of the initial error, a 0.1 recovery factor (Ref. 7-3) is applied to the initial human error probability. Moreover, the second operator assisting with the unloading operation can prevent a mine from being left in the dunnage box if he sees the first operator placing it in the box, or if he sees the mine in the box while loading it. A human error probability of 0.01 was assigned to the second operator. Therefore, the overall failure probability per drum was calculated as follows:

$$10^{-2} \times 10^{-2} \times 0.1 \times 10^{-2} = 10^{-7}/\text{drum}$$

The frequency of inadvertently feeding a mine to the DUN is the product of the failure probability per drum multiplied by the number of mine drums processed per year.

Rockets, Mortars, and 105s

Inadvertently feeding a rocket, mortar, or 105 to the DUN requires that the following two faults occur:

1. The operators mistakenly leave a munition in the dunnage box.
2. The operator responsible for inspecting the dunnage box prior to charging it to the DUN fails to detect the munition.

From the analysis for the mines, the probability that the operators mistakenly leave a munition in the dunnage box is 10^{-5}. Since rockets, mortars, and 105s are sent to the UPA without all of the packing used for mines, the operator responsible for inspecting the dunnage box has

an excellent chance of detecting a munition mistakenly left in the dunnage box. Assigning an error probability of 0.01 to this inspection results in an overall failure probability per pallet of:

$$10^{-5} \times 10^{-2} = 10^{-7}/\text{pallet}$$

The frequency of inadvertently feeding a rocket, mortar, or 105 to the DUN is the product of the failure probability per pallet multiplied by the number of pallets processed per year.

Other Munitions

Mines, mortars, 105 mm projectiles, and rockets weigh 23, 25, 32, and approximately 56 lb, respectively. Because of their weight, these munitions can be handled by a single operator. All other munitions weigh in excess of 100 lb, except 155 mm projectiles which have a 95-lb minimum weight. Because of their weight, these munitions cannot be easily handled by a single operator. Although these other munitions can be fed to the DUN, the likelihood of this occurring is dominated by the probability that at least one operator commits an act of sabotage. The probability of this event cannot be quoted in an unclassified document.

7.1.6. Accident Analysis Summary and Results

Table 7-6 lists the internally-initated plant accident sequences which survived the preliminary screening. A complete list of all the accident sequences identified is provided in Appendix A.

Table 7-7 presents the accident frequency results for these sequences. The values shown are median values. The range factor column represents the rates of the 95th percentile value to the median value. More details on the uncertainty analysis are discussed in Secetion 7.3.

TABLE 7-6
INTERNAL EVENTS ACCIDENT SEQUENCES

Scenario ID	Description
P041	Failure to stop agent feed to the LIC, overloads the ventilation system.
P042	MPF explosion due to failure to stop fuel flow after a shutdown.
P043	MPF explosion due to hydraulic rupture of an unpunched bulk item. MPF room and ventilation integrity maintained.
P044	MPF explosion due to hydraulic rupture of an unpunched bulk item. MPF room or ventilation integrity lost.
P045	Ton container is spilled in the ECV, MDB structure fails due to subsequent agent fire.
P046	Munition detonation in the ECV, no fire.
P047	Munition detonation in the ECV, fire results but does not propagate.
P048	Munition detonation in ECV, fire results and propagates.
P049	Munition detonation in ECR causes structural and ventilation system failure.
P050	Munition detonation in ECR causes structural failure, a fire, and ventilation failure.
P051	Ton container spile in the MPB results in fire and structural failure.
P052	A burstered munition is fed to the DUN.

TABLE 7-7
PLANT OPERATIONS INTERNALLY-INITIATED ACCIDENT
SEQUENCE FREQUENCIES (EVENTS/YEAR)

DATE21-Aug-97 PAGE1 PLTOPSQS

PLANT OPERATIONS INTERNAL INITIATING EVENTS
RDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

PLANT OPERATIONS INTERNAL INITIATING EVENTS
NDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

	SCENA NUMBE	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
-----	------	------	------	------	------	------	------
POAGC	41	3.3E-10	4.8E+01	3.3E-10	4.8E+01	3.3E-10	4.8E+01
POAHC	41	3.3E-10	4.8E+01	3.3E-10	4.8E+01	3.3E-10	4.8E+01
POAVC	41	3.3E-10	4.8E+01	3.3E-10	4.8E+01	3.3E-10	4.8E+01
POBGC	42	N/A	--	9.9E-09	3.7E+01	9.9E-09	3.7E+01
PODHC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01
POCGC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01
POCHC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01
POKGC	42	N/A	--	9.9E-09	3.7E+01	9.9E-09	3.7E+01
POKHC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01
POKVC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01
PONVC	42	N/A	--	N/A	--	N/A	--
POPGC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01
POPHC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01
POPVC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01
POQGC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01
POQVC	42	N/A	--	9.9E-09	3.7E+01	9.9E-09	3.7E+01
PORGC	42	N/A	--	N/A	--	N/A	--
PORVC	42	N/A	--	N/A	--	N/A	--
POSVC	42	N/A	--	9.9E-09	3.7E+01	9.9E-09	3.7E+01
POBGC	43	N/A	--	1.6E-09	4.1E+01	1.6E-09	4.1E+01
POKGC	43	N/A	--	2.3E-10	4.1E+01	2.3E-10	4.1E+01
POKHC	43	2.7E-10	4.1E+01	2.7E-10	4.1E+01	2.7E-10	4.1E+01
POKVC	43	1.5E-10	4.1E+01	1.5E-10	4.1E+01	1.5E-10	4.1E+01
POSVC	43	N/A	--	1.8E-10	4.1E+01	1.8E-10	4.1E+01
POBGC	44	N/A	--	1.6E-10	4.1E+01	1.6E-10	4.1E+01
POKGC	44	N/A	--	2.3E-10	4.1E+01	2.3E-10	4.1E+01
POKHC	44	2.7E-10	4.1E+01	2.7E-10	4.1E+01	2.7E-10	4.1E+01
POKVC	44	1.5E-10	4.1E+01	1.5E-10	4.1E+01	1.5E-10	4.1E+01
POSVC	44	N/A	--	1.8E-10	4.1E+01	1.8E-10	4.1E+01

TABLE 7-7 (Continued)

DATE21-Aug-87 PAGE2 PLTOPSOS

PLANT OPERATIONS INTERNAL INITIATING EVENTS
RDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

PLANT OPERATIONS INTERNAL INITIATING EVENTS
NDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

	SCENA NUMBE	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
POKGF	45	N/A	--	4.0E-09	1.4E+01	4.0E-09	1.4E+01
POKHF	45	4.0E-10	1.4E+01	4.0E-10	1.4E+01	4.0E-10	1.4E+01
POKVF	45	4.0E-10	1.4E+01	4.0E-10	1.4E+01	4.0E-10	1.4E+01
PODHC	46	9.0E-09	2.6E+01	9.0E-09	2.6E+01	9.0E-09	2.6E+01
POCGC	46	1.0E-08	2.6E+01	1.0E-08	2.6E+01	1.0E-08	2.6E+01
POCHC	46	1.0E-08	2.6E+01	1.0E-08	2.6E+01	1.0E-08	2.6E+01
POMVC	46	4.0E-07	2.6E+01	4.0E-07	2.6E+01	4.0E-07	2.6E+01
POPGC	46	6.0E-07	2.6E+01	6.0E-07	2.6E+01	6.0E-07	2.6E+01
POPHC	46	6.0E-07	2.6E+01	6.0E-07	2.6E+01	6.0E-07	2.6E+01
POPVC	46	6.0E-07	2.6E+01	6.0E-07	2.6E+01	6.0E-07	2.6E+01
POQGC	46	3.0E-07	2.6E+01	3.0E-07	2.6E+01	3.0E-07	2.6E+01
POQVC	46	N/A	--	3.0E-07	2.6E+01	3.0E-07	2.6E+01
PORGC	46	1.5E-07	2.7E+01	1.5E-07	2.7E+01	1.5E-07	2.7E+01
PORVC	46	1.5E-07	2.7E+01	1.5E-07	2.7E+01	1.5E-07	2.7E+01
PODHC	47	8.1E-11	3.1E+01	8.1E-11	3.1E+01	8.1E-11	3.1E+01
POCGC	47	9.0E-11	3.1E+01	9.0E-11	3.1E+01	9.0E-11	3.1E+01
POCHC	47	9.0E-11	3.1E+01	9.0E-11	3.1E+01	9.0E-11	3.1E+01
POMVC	47	3.6E-09	3.1E+01	3.6E-09	3.1E+01	3.6E-09	3.1E+01
POPGC	47	5.4E-09	3.1E+01	5.4E-09	3.1E+01	5.4E-09	3.1E+01
POPHC	47	5.4E-09	3.1E+01	5.4E-09	3.1E+01	5.4E-09	3.1E+01
POPVC	47	5.4E-09	3.1E+01	5.4E-09	3.1E+01	5.4E-09	3.1E+01
POQGC	47	2.7E-09	3.1E+01	2.7E-09	3.1E+01	2.7E-09	3.1E+01
POQVC	47	N/A	--	2.7E-09	3.1E+01	2.7E-09	3.1E+01
PORGC	47	1.5E-07	2.7E+01	1.5E-07	2.7E+01	1.5E-07	2.7E+01
PORVC	47	1.5E-07	2.7E+01	1.5E-07	2.7E+01	1.5E-07	2.7E+01
PODHC	48	9.0E-12	3.3E+01	9.0E-12	3.3E+01	9.0E-12	3.3E+01
POCGC	48	1.0E-11	3.3E+01	1.0E-11	3.3E+01	1.0E-11	3.3E+01
POCHC	48	1.0E-11	3.3E+01	1.0E-11	3.3E+01	1.0E-11	3.3E+01
POMVC	48	4.0E-10	3.3E+01	4.0E-10	3.3E+01	4.0E-10	3.3E+01

TABLE 7-7 (Continued)

DATE21-Aug-87 PAGE3 PLTOPSDS

PLANT OPERATIONS INTERNAL INITIATING EVENTS
RDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

PLANT OPERATIONS INTERNAL INITIATING EVENTS
NDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

-----	SCENA NUMBE	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
POPGC	48	6.0E-10	3.3E+01	6.0E-10	3.3E+01	6.0E-10	3.3E+01
POPHC	48	6.0E-10	3.3E+01	6.0E-10	3.3E+01	6.0E-10	3.3E+01
POPVC	48	6.0E-10	3.3E+01	6.0E-10	3.3E+01	6.0E-10	3.3E+01
POQGC	48	3.0E-10	3.3E+01	3.0E-10	3.3E+01	3.0E-10	3.3E+01
POQVC	48	N/A	--	3.0E-10	3.3E+01	3.0E-10	3.3E+01
PORGC	48	1.5E-09	3.2E+01	1.5E-09	3.2E+01	1.5E-09	3.2E+01
PORVC	48	1.5E-09	3.2E+01	1.5E-09	3.2E+01	1.5E-09	3.2E+01
PODHC	49	3.0E-06	3.1E+01	3.0E-06	3.1E+01	3.0E-06	3.1E+01
POCGC	49	4.0E-06	3.1E+01	4.0E-06	3.1E+01	4.0E-06	3.1E+01
POCHC	49	4.0E-06	3.1E+01	4.0E-06	3.1E+01	4.0E-06	3.1E+01
POMVC	49	4.0E-09	3.7E+01	4.0E-09	3.7E+01	4.0E-09	3.7E+01
POPGC	49	2.0E-06	3.1E+01	2.0E-06	3.1E+01	2.0E-06	3.1E+01
POPHC	49	2.0E-06	3.1E+01	2.0E-06	3.1E+01	2.0E-06	3.1E+01
POPVC	49	2.0E-06	3.1E+01	2.0E-06	3.1E+01	2.0E-06	3.1E+01
POQGC	49	8.0E-07	3.1E+01	8.0E-07	3.1E+01	8.0E-07	3.1E+01
POQVC	49	N/A	--	8.0E-07	3.1E+01	8.0E-07	3.1E+01
PORGC	49	5.0E-07	3.4E+01	5.0E-07	3.4E+01	5.0E-07	3.4E+01
PORVC	49	5.0E-07	3.4E+01	5.0E-07	3.4E+01	5.0E-07	3.4E+01
PODHC	50	3.0E-08	3.7E+01	3.0E-08	3.7E+01	3.0E-08	3.7E+01
POCGC	50	4.0E-08	3.7E+01	4.0E-08	3.7E+01	4.0E-08	3.7E+01
POCHC	50	4.0E-08	3.7E+01	4.0E-08	3.7E+01	4.0E-08	3.7E+01
POMVC	50	4.0E-11	3.7E+01	4.0E-11	3.7E+01	4.0E-11	3.7E+01
POPGC	50	2.0E-08	3.7E+01	2.0E-08	3.7E+01	2.0E-08	3.7E+01
POPHC	50	2.0E-08	3.7E+01	2.0E-08	3.7E+01	2.0E-08	3.7E+01
POPVC	50	2.0E-08	3.7E+01	2.0E-08	3.7E+01	2.0E-08	3.7E+01
POGGC	50	8.0E-09	3.7E+01	8.0E-09	3.7E+01	8.0E-09	3.7E+01
POQVC	50	N/A	--	8.0E-09	3.7E+01	8.0E-09	3.7E+01
PORGC	50	5.0E-07	3.4E+01	5.0E-07	3.4E+01	5.0E-07	3.4E+01
PORVC	50	5.0E-07	3.4E+01	5.0E-07	3.4E+01	5.0E-07	3.4E+01

TABLE 7-7 (Continued)

DATE21-Aug-87 PAGE4 PLTOPSOS

PLANT OPERATIONS INTERNAL INITIATING EVENTS
RDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

PLANT OPERATIONS INTERNAL INITIATING EVENTS
NDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

-----	SCENA NUMBE	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
POKGF	51	N/A	--	4.0E-09	1.4E+01	4.0E-09	1.4E+01
POKHF	51	4.0E-09	1.4E+01	4.0E-09	1.4E+01	4.0E-09	1.4E+01
POKVF	51	4.0E-09	1.4E+01	4.0E-09	1.4E+01	4.0E-09	1.4E+01
PODHC	52	4.4E-03	5.7E+01	4.4E-03	5.7E+01	4.4E-03	5.7E+01
POCGC	52	5.0E-03	5.7E+01	5.0E-03	5.7E+01	5.0E-03	5.7E+01
POCHC	52	5.0E-03	5.7E+01	5.0E-03	5.7E+01	5.0E-03	5.7E+01
POMVC	52	1.1E-02	5.7E+01	1.1E-02	5.7E+01	1.1E-02	5.7E+01
POPGC	52	NEGL	--	NEGL	--	NEGL	--
POPHC	52	NEGL	--	NEGL	--	NEGL	--
POPVC	52	NEGL	--	NEGL	--	NEGL	--
POQGC	52	NEGL	--	NEGL	--	NEGL	--
POQVC	52	N/A	--	NEGL	--	NEGL	--
PORGC	52	1.6E-03	5.7E+01	1.6E-03	5.7E+01	1.6E-03	5.7E+01
PORVC	52	1.6E-03	5.7E+01	1.6E-03	5.7E+01	1.6E-03	5.7E+01

7.2. EXTERNAL EVENTS

The following external event initiators were considered in the development of plant-related accident scenarios which could lead to the release of a significant amount of chemical agent:

1. Tornadoes and high winds.
2. Meteorite strikes.
3. Aircraft crashes.
4. Earthquakes.
5. Lightning.

For this study, the demil facility is defined to include (1) the MHI where munitions awaiting demilitarization are temporarily stored and (2) the MDB which houses the systems and equipments to destroy the explosives and agent contained in the various munitions. The accident sequences identified were subjected to a preliminary screening process by assigning very conservative failure probability values. The screening criteria for frequency and agent release are described in Section 4.

The initiating event families for plan operations were identified in Section 4.1. Table 7-8 lists the accident sequences related to plant operations initiated by external events. The event tree models are presented in Figs. 7-39 through 7-44.

7.2.1. Tornadoes and High Winds

The accident scenarios identified involve the breaching of the munitions in the MHI and the UPA by tornado- or high wind-generated missiles. This failure mode was determined to be more credible than a tornado/high wind-induced building collapse which could lead to the crushing of munitions by the falling structure. For UBC designed structures such as the MDB, the wind loads will fail the walls of the

TABLE 7-8
MASTER LIST OF EXTERNALLY-INITIATED PLANT ACCIDENT SCENARIOS

Scenario ID	Description
P01	Tornado-generated missile puncture/crush munitions in the MHI.
P02	Tornado-generated missile detonate munitions in the MHI.
P03	Tornado-generated missile puncture/crush munitions in the UPA.
P04	Tornado-generated missile detonate munitions in the UPA.
P05	Tornado-generated missile damages the agent piping system between the BDS and TOX at TEAD (bulk-only facility).
P06	Meteorite strikes the MHI.
P07	Meteorite strikes the UPA.
P07A	Meteorite strikes the TOX.
P08	Meteorite strikes the agent piping system between the BDS and TOX at TEAD (bulk-only facility).
P09	Direct large aircraft crash onto the MHI; no fire.
P010	Direct large aircraft crash onto the MHI; fire not contained in 0.5 h.
P011	Direct large aircraft crash onto the MHI; fire contained in 0.5 h.
P012	Direct large aircraft crash damages the MDB; no fire.
P013	Direct large aircraft crash damages the MDB; fire not contained in 0.5 h.
P014	Direct large aircraft crash damages the MDB; fire contained in 0.5 h.
P015	Indirect large aircraft crash damages the MHI; no fire.
P016	Indirect large aircraft crash damages the MHI; fire not contained in 0.5 h.
P017	Indirect large aircraft crash damages the MHI; fire contained in 0.5 h.

TABLE 7-8 (Continued)

Scenario ID	Description
P018	Indirect large aircraft crash damages the MDB; no fire.
P019	Indirect large aircraft crash damages the MDB; fire not contained in 0.5 h.
P020	Indirect large aircraft crash damages the MDB; fire contained in 0.5 h.
P021	Direct crash of a large or small aircraft damages the outdoor agent piping system at TEAD; no fire.
P022	Direct crash of a large or small aircraft damages the outdoor agent piping system at TEAD; fire occurs and not contained.
P023	Earthquake causes the munitions in the MHI to fall and be punctured.[a]
P024	Earthquake causes munitions in the MHI to fall and detonate.[a]
P025	Earthquake damages the MDB structure, munitions fall and are punctured; fire suppressed.
P026	Earthquake damages the MDB structure, munitions fall and are punctured; earthquake also initiates fire; fire suppression system fails.
P028A[b]	Earthquake damages the MDB structure, munitions fall and are punctured; TOX damaged; fire occurs; fire suppressed.
P028	Earthquake damages the MDB structure, munitions fall and are punctured; TOX damaged; fire occurs; fire suppression system fails.
P029	Earthquake damages the MDB; munitions are intact; fire occurs; fire suppression system fails.
P030	Earthquake damages the MDB; munitions are intact; TOX damaged; no fire occurs.[c]
P031A	Earthquake damages the MDB; munitions are intact; TOX damaged; fire occurs; fire suppressed.
P031	Earthquake damages the MDB; munitions are intact; TOX damaged; fire occurs; fire not suppressed.

TABLE 7-8 (Continued)

Scenario ID	Description
P032	Earthquake causes munitions to fall and detonate; MDB breached by detonation; the TOX is intact; no fire.[c]
P033	Earthquake causes munitions to fall but no detonation occurs; the MDB is intact; the TOX is intact; earthquake also initiates fire; fire suppression system fails.
P034	Earthquake causes munitions to fall but no detonation occurs; the MDB is intact; the TOX is damaged; fire occurs; fire suppression system fails.

[a]Screened out due to design changes.
[b]Sequence 27 not used.
[c]Screened out on the basis of frequency.

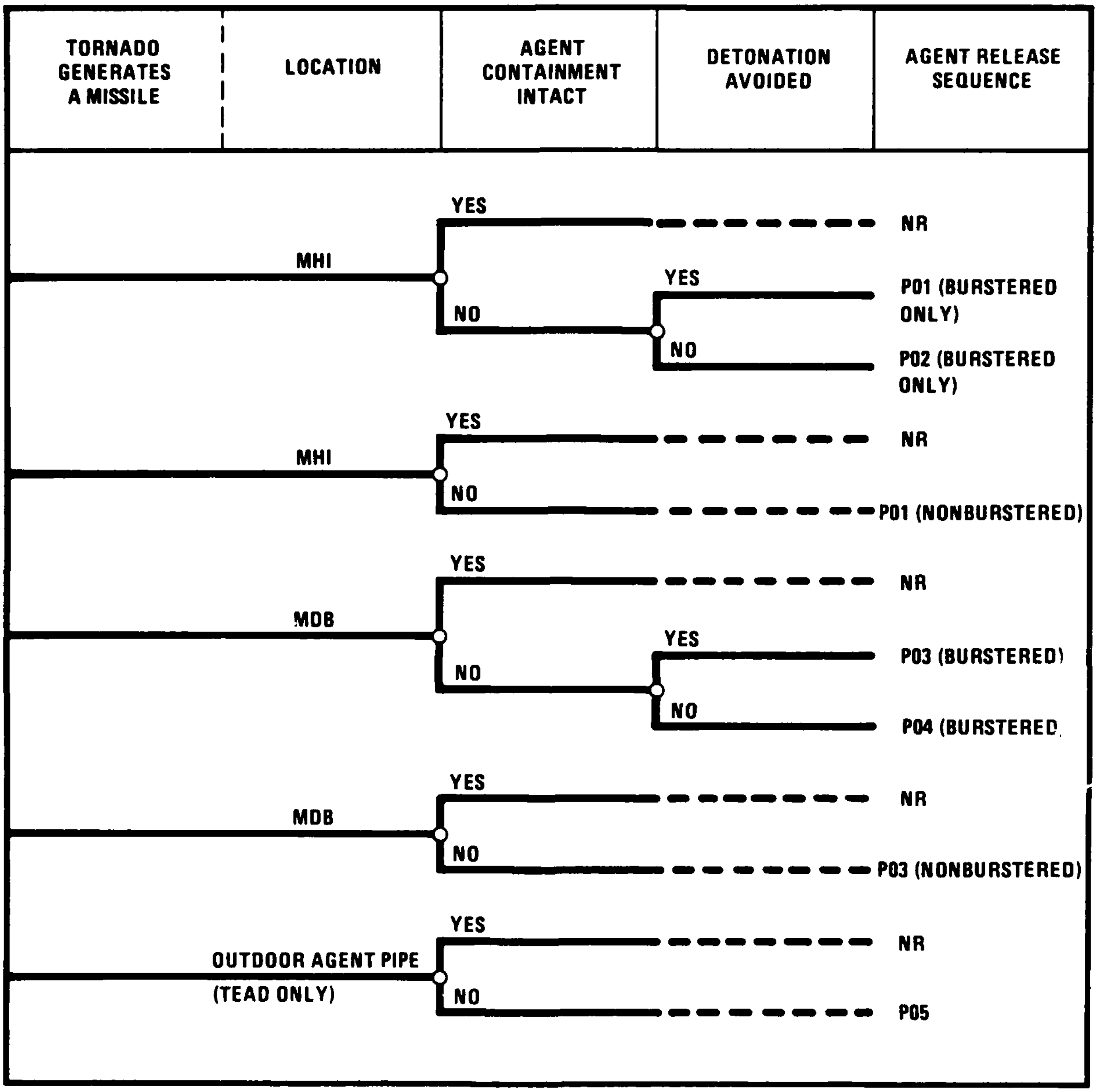


Fig. 7-39. Tornado-induced agent release scenarios

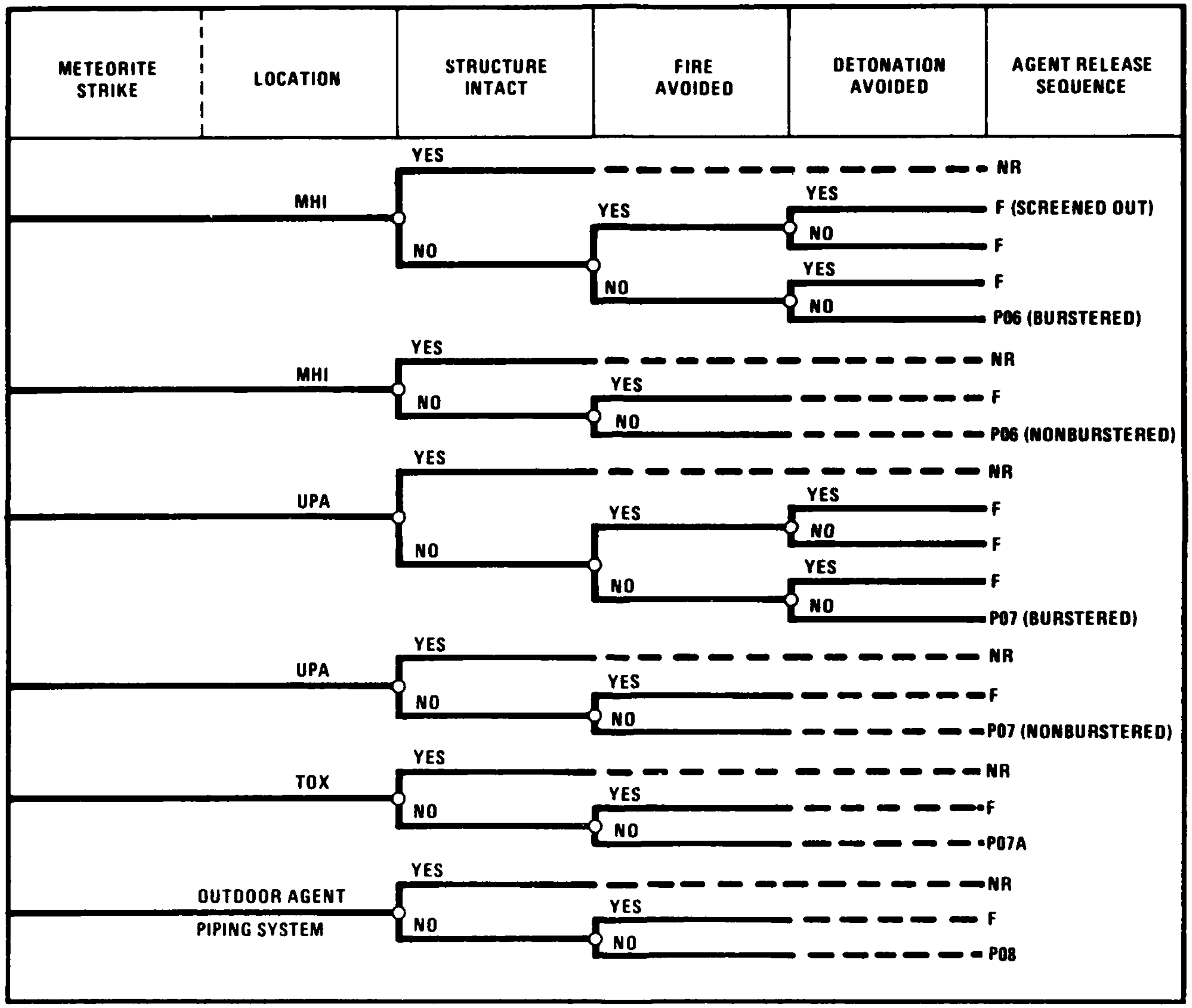


Fig. 7-40. Meteorite-induced agent release scenarios

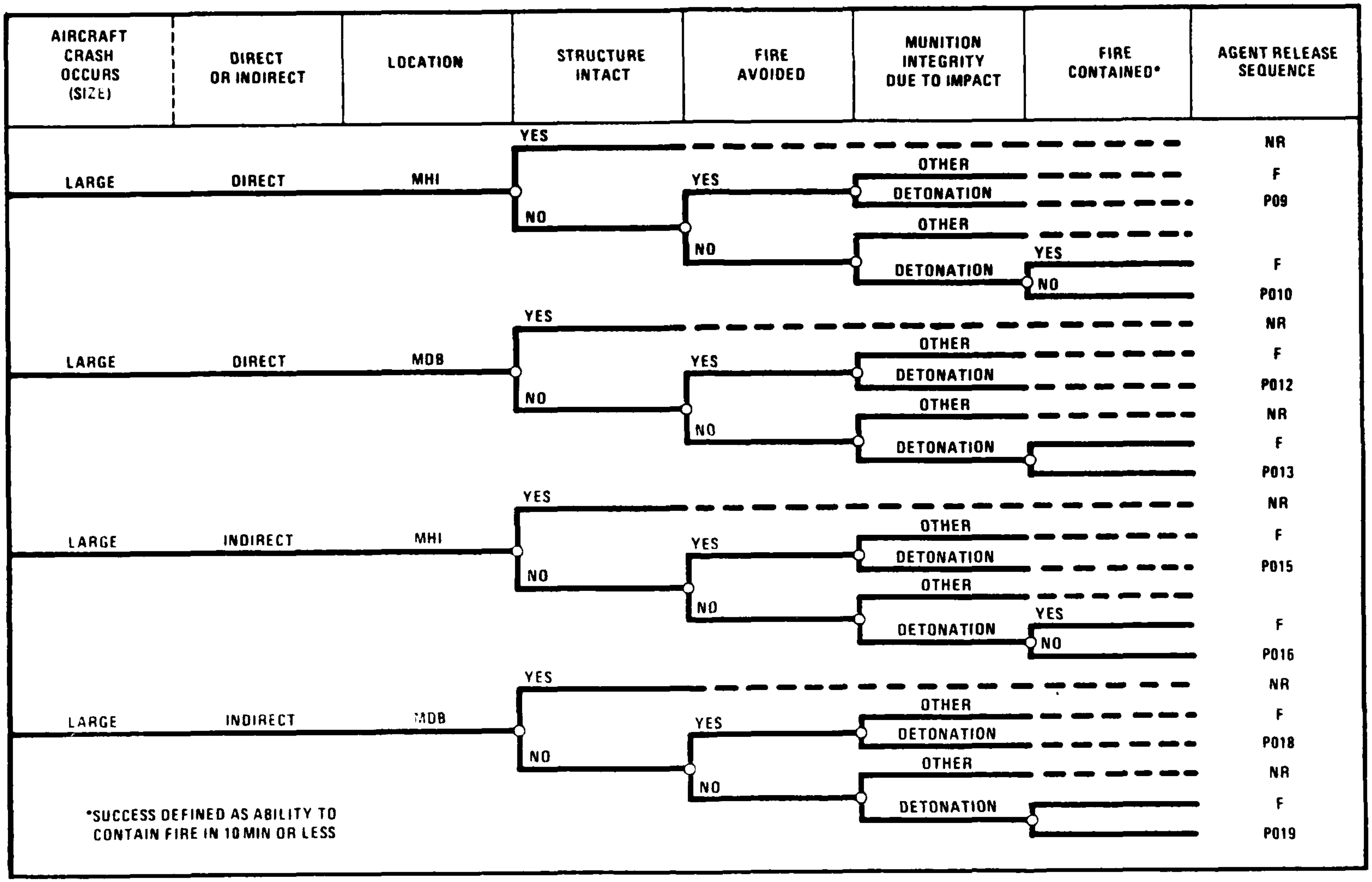


Fig. 7-41. Large aircraft crash onto MHI/MDB containing burstered munitions

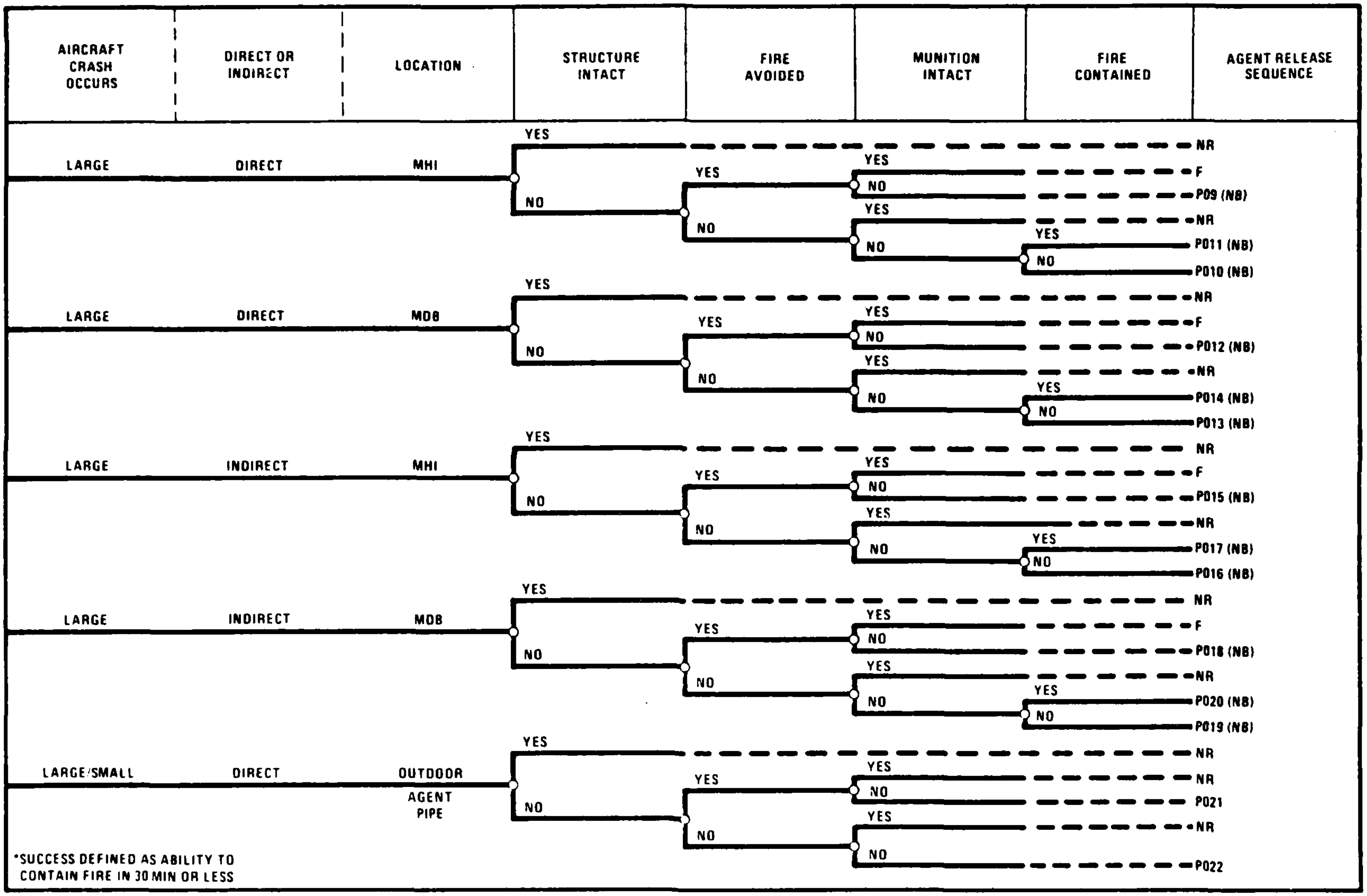


Fig. 7-42. Aircraft crash onto MHI/MDB with nonburstered (NB) munitions

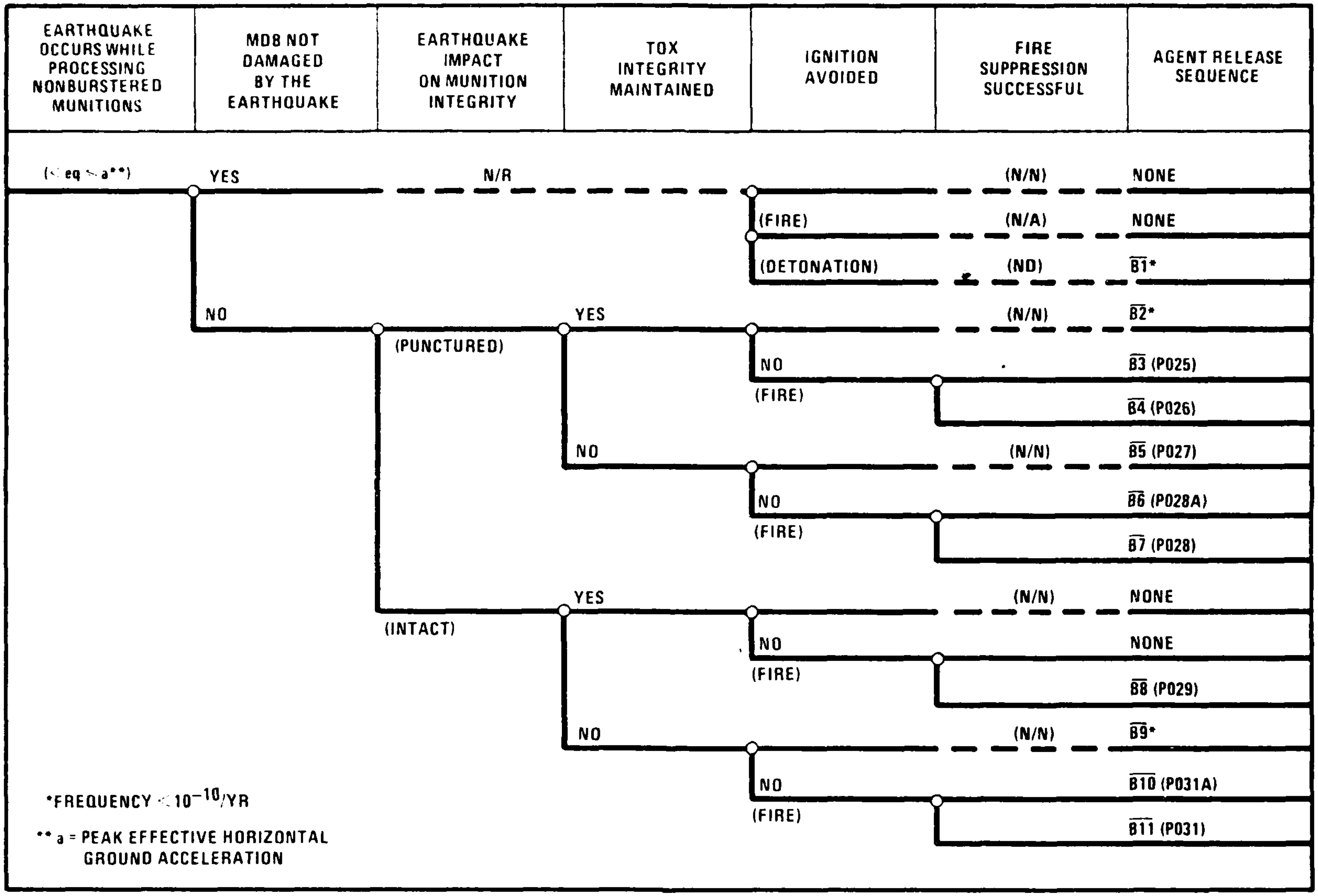


Fig. 7-43. Event tree: earthquake-induced releases from the MDB involving bulk containers

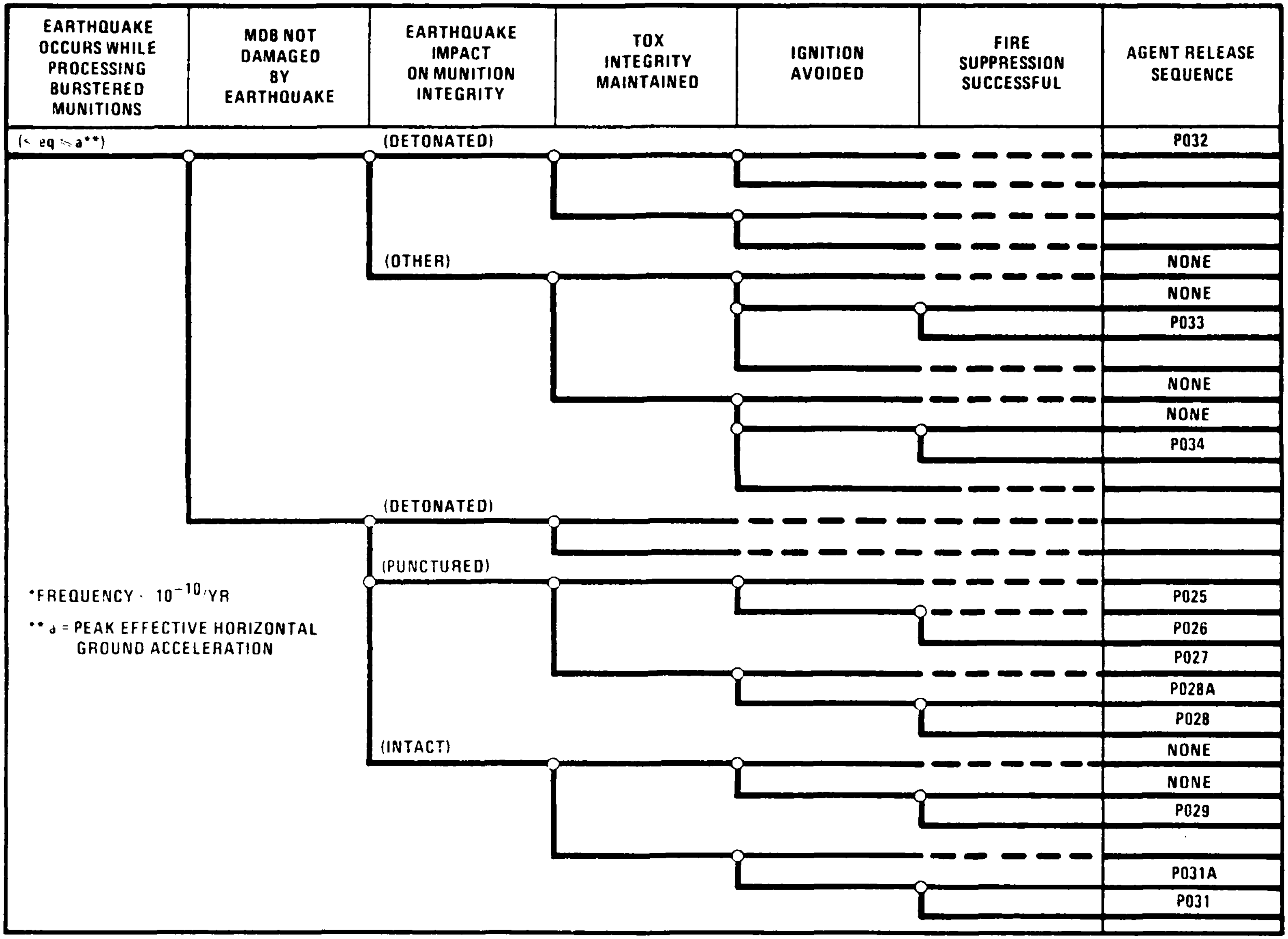


Fig. 7-44. Event tree: earthquake-induced releases from the MDB involving burstered munitions

structure before the structure will collapse. Storage igloos like the MHI have been designed to resist the direct effects of tornadoes with winds up to 320 mph except for the possibility of missiles breaching the igloo doors (Ref. 7-4). In the MDB, only the UPA has been determined to be vulnerable to tornado/high wind-generated missiles that could result in significant agent releases.

An additional scenario that applies to the modified CAMDS facility at TEAD has been identified. This involves the susceptibility of the outdoor agent piping system that links the bulk drain station and the TOX which will be located in a separate building.

The event tree developed to define relevant accident sequences is shown in Fig. 7-39. No sequences could be screened out initially as more detailed quantitative analysis is required to determine the necessary wind velocity to generate missiles which could penetrate the munitions. Hence, all the accident sequences numbered in the event tree were quantified. They are:

P01 - Tornado-generated missiles puncture/crush the munitions in the MHI.

P02 - Tornado-generated missiles detonate the burstered munitions in the MHI.

P03 - Tornado-generated missiles breach the munitions in the UPA.

P04 - Tornado-generated missiles detonate the burstered munitions in the UPA.

P05 - Tornado-generated missiles breach the agent piping system between the BDS and TOX at TEAD (CAMDS-modified bulk only facility).

7.2.1.1. Tornado and High Wind Accident Analysis. Essentially, the missile penetration of the munition inside the MHI or UPA occurs if (1) a tornado or extremely high wind occurs with a velocity sufficient to generate a missile that could penetrate the MHI door or UPA wall and a munition, and (2) the missile actually hits the target munition. The probability of a missile hitting and rupturing a munition is the product of four variables: (1) the probability that the velocity vector of the missile is nearly perpendicular to the target; (2) the probability that the missile is oriented properly to penetrate the target; (3) the number of missiles per square foot of wind; and (4) the target area. More details on the derivation of these variables are provided in the calculation sheets (Ref. 7-5). If the missile hits a burstered munition, two failure modes are possible, (1) the munition is opened up due to puncture or crush, or (2) the missile impact causes munition detonation due to the application of a force greater than the "undue force."

Scenario P01 - Tornado-Generated Missile Penetrates Munitions in the MHI (No Detonations Occur)

The MHI is assumed to be an 80-ft long by 27-ft wide igloo with a concrete door for all sites. The munitions are stored in onsite transportation containers, except the spray tanks and wet eye bombs which are in their existing overpacks and not in onsite transportation containers. There will be a maximum of 16 containers in the MHI.

For an agent release to occur, the missile must penetrate the igloo door, the onsite container, and the munition itself. The required initial velocity (V) to puncture the munition is given by:

$$V = V_D^2 + V_C^2 + V_m^2 \quad , \tag{7-1}$$

where V_D = door penetration velocity,

V_C = onsite container penetration velocity,

V_m = munition penetration velocity (munition specific).

The puncture velocity for a concrete igloo door has been analyzed previously (Ref. 7-5) and was calculated to be 54 mph assuming the missile is a utility pole. The puncture velocity for the onsite container was calculated to be 63 mph. The penetration velocity for the munition itself is munition specific and is largely a function of the thickness of the munition. Details are provided in the calculation sheets. Having calculated the required initial missile velocity, the required wind velocity to generate the missile is determined in Section 4.2. The frequency of occurrence of a given wind speed is determined from the set of curves given in Section 4.

Scenario PO2 - Tornado-Generated Missile Penetrate Munitions in the MHI; Detonation Results from Impact

The analysis of scenarios PO2 included the estimation of the probability that a missile impacting a munition would cause it to detonate. The data presented in Ref. 7-6 indicated that a projectile with Comp B explosive could ignite when subjected to a minimum impact velocity of 123 mph. Because the conditions of the tests described in Ref. 7-6 do not fully apply to the conditions being considered here (i.e., the shell casing provides protection for the bursters), it is assumed that there is a 50% chance that a munition will detonate at 123 mph. Furthermore, we also estimate the probability of a detonation resulting from a drop of the munition from a height of 40 ft to be 10^{-3} (Ref. 7-9). The 40 ft drop height corresponds to a free fall velocity (in a vacuum) of about 34.6 mph. To determine the probability of detonating a munition at an impact velocity equivalent to that of a missile required to penetrate the igloo and the munition, we assumed a lognormal distribution and derived the necessary parameters (e.g., standard deviation and standard normal deviate) from these two data points. The results are shown in the data base table (Table 7-9). The calculation details are given in the calculation sheets (Ref. 7-5).

TABLE 7-9
DATA BASE FOR TORNADO-INITIATED EVENTS FOR PLANT OPERATIONS

24-Jul-87 Page 1

Data Base For Tornado-Initiated Events For Plant Operations

Event	Site	Munition Type	Variable Name	MHI	Variable Name	MDB	Variable Name	Open Area	Error Factor	Reference
1. Frequency wind sufficient to generate missile	ANAD	105-mm cartrg	ANMHIC	8.9E-07	ANMDBC	1.5E-06			10	SEE CALC SHEETS
		4.2-in mortar	ANMHID	1.1E-06	ANMDBD	1.5E-06			10	
		ton contnr	ANMHIK	1.4E-07	ANMDBK	7.3E-07			10	
		mine	ANMHIM	1.1E-06	ANMDBM	1.5E-06			10	
		155-mm proj	ANMHIP	7.4E-07	ANMDBP	1.5E-06			10	
		8-in proj	ANMHIQ	7.4E-07	ANMDBQ	1.5E-06			10	
		rockets	ANMHIR	1.1E-06	ANMDBR	1.5E-06			10	
	APG	ton contnr			APMDBK	4.5E-08				
	LBAD	155-mm proj	LBMHIP	1.3E-06	LBMDBP	1.5E-06			10	
		8-in proj	LBMHIQ	1.5E-06	LBMDBQ	1.5E-06			10	
		rocket	LBMHIR	1.5E-06	LBMDBR	1.5E-06			10	
	NAAP	ton contnr			NAMDBK	7.3E-07			10	
	PBA	ton contnr	PBMHIK	3.8E-07	PBMDBK	7.3E-07				
		mine	PBMHIM	1.5E-06	PBMDBM	1.5E-06			10	
		rocket	PBMHIR	1.5E-06	PBMDBR	1.5E-06			10	
	PUDA	105-mm cartrg	PUMHIC	1.0E-07	PUMDBC	1.0E-07			10	
		4.2-in mortar	PUMHID	1.0E-07	PUMDBD	1.0E-07			10	
		155-mm proj	PUMHIP	1.0E-07	PUMDBP	1.0E-07			10	
	TEAD	bomb	TEMHIB	3.6E-10	TEMDBB	8.1E-10			10	
		105-mm cartrg	TEMHIC	1.8E-09	TEMDBC	1.8E-09			10	
		4.2-in mortar	TEMHID	1.8E-09	TEMDBD	1.8E-09			10	
		ton contnr	TEMHIK	2.4E-10	TEMDBK	7.3E-10			10	
		mine	TEMHIM	1.8E-09	TEMDBM	1.8E-09			10	
		155-mm proj	TEMHIP	1.5E-09	TEMDBP	1.8E-09			10	
		8-in proj	TEMHIQ	1.8E-09	TEMDBQ	1.8E-09			10	
		rocket	TEMHIR	1.8E-09	TEMDBR	1.8E-09			10	
		spray tank	TEMHIS	1.1E-09	TEMDBS	1.8E-09			10	
	UMDA	bomb	UMMHIB	3.6E-10	UMMDBB	8.1E-10			10	
		ton contnr	UMMHIK	2.4E-10	UMMDBK	7.3E-10			10	
		mine	UMMHIM	1.8E-09	UMMDBM	1.8E-09			10	
		155-mm proj	UMMHIP	1.5E-09	UMMDBP	1.8E-09			10	
		8-in proj	UMMHIQ	1.8E-09	UMMDBQ	1.8E-09			10	
		rocket	UMMHIR	1.8E-09	UMMDBR	1.8E-09			10	
		spray tank	UMMHIS	1.1E-09	UMMDBS	1.8E-09			10	
	TEAD	B,K,S(PIPE)					CDOPA	1.8E-09	10	

TABLE 7-9 (Continued)

2. Probability munition penetrated	All	bomb	MHIPTB	4.3E-07	MDBPTB	2.6E-06			50
		105-mm cartrg	MHIPTC	2.4E-07	MDBPTC	1.5E-06			50
		4.2-in mortar	MHIPTD	7.3E-07	MDBPTD	4.4E-06			50
		ton contnr	MHIPTK	8.2E-07	MDBPTK	4.9E-06			50
		mine	MHIPTM	8.6E-07	MDBPTM	5.1E-06			50
		155-mm proj	MHIPTP	3.8E-07	MDBPTP	2.3E-06			50
		8-in proj	MHIPTQ	3.8E-07	MDBPTQ	2.3E-06			50
		rocket	MHIPTR	7.8E-07	MDBPTR	4.7E-06			50
		spray tank	MHIPTS	3.4E-07	MDBPTS	8.4E-06			50
	All	All	IGLPT	3.2E-06					50
3. Prob. pipe penetrated	TEAD	B,K,S(PIPE)					CDPTP	1.3E-02	50
4. Munition detonates	All	All	DEMHI	1.7E-01	DEMDB	7.0E-02			2

Sequence P03 - Tornado-Generated Missile Penetrate Munitions in the UPA

Except for accounting for the difference in the structure of the UPA, the same analytical approach described in scenario P01 was used. The UPA is located on the second floor of the MDB and will contain as many as six onsite containers at any given time. The wall of the MDB is constructed of two layers of thin steel sheets (thickness is approximately 0.047 in.), separated by an insulation material for a total thickness of approximately 2 in. Details of the analysis are given in the calculation sheets (Ref. 7-5).

Sequence P04 - Tornado-Generated Missile Penetrate Munitions in the UPA; Burstered Munitions Detonate Upon Impact

The analysis of sequence P04 follows the same approach as sequence P02. The probability of munition detonation is calculated from the missile impact velocity upon penetration. Details are given in the calculation sheets (Ref. 7-5).

Sequence P05 - Tornado-Generated Missile Breach the Outdoor Agent Piping System at the Modified CAMDS Bulk-Only Facility

Analysis of sequence P05 also followed the same approach described above except that only a double-walled pipe had to be breached in order to result in an agent release.

7.2.2. Meteorite Strikes

Like tornado-generated missiles, meteorites striking the MHI, MDB, and the outdoor agent piping system at TEAD can lead to a significant amount of agent release. The consequence of such an accident is more severe than that from a tornado-generated missile because meteorite strikes generally involve fires. Hence, if burstered munitions are

involved, explosive detonations could occur from the fire or from direct impact, leading to instantaneous agent releases.

The event tree developed for meteorite-initiated accidents is shown in Fig. 7-30. The sequences could not be subjected to any preliminary screening without doing a more detailed analysis of the what type (stone or iron) and size of meteorite is capable of penetrating munitions in the MHI or damaging the MDB which contain not only intact munitions (primarily in the UPA) but a large agent holding tank (in the TOX).

The accident sequences identified are:

P06 - Meteorite strikes the MHI and if burstered munitions are involved, detonations are assumed to occur.

P07 - Meteorite strikes the UPA and if burstered munitions are involved, detonations are assumed to occur.

P07A - Meteorite strikes the TOX.

P08 - Meteorite strikes the outdoor agent piping system at TEAD (CAMDS-modified bulk only facility).

7.2.2.1. Meteorite Strike Accident Analysis. The frequency of meteorite strikes for meteorites weighing 1.0 lb or greater is $(6.4 \times 10^{-13})/ft^2$ (Ref. 7-7). For small meteorites (one ton or less), stone meteorites are approximately ten time more common than iron. However, iron meteorites are more dense and tend to have higher impact velocities and therefore represent a significant portion of the total meteorites that can rupture the munitions. The meteorite size distribution data has been presented in Section 4.2.

Sequence P06 - Meteorite Strikes the MHI

The munitions in the MHI are stored in their onsite transportation containers. For agent to be released given a meteorite strike, the meteorite has to penetrate 2 ft of soil and 6 in. of concrete roof, the onsite container, and the munition wall. Hence, there are essentially four layers of structural barrier. The minimum meteorite impact velocity that would collapse the 6-in. thick concrete roof is 1500 fps for a stone meteorite and 3800 fps for an iron meteorite. The overall frequency of a meteorite capable of penetrating and rupturing the munitions in the MHI is:

$$F_t = F(f_s + f_i)\ A \times S \quad , \tag{7-2}$$

where F = the frequency of a meteorite weighing one pound or more striking the earth, $6.4 \times 10^{-13}/ft^2$,

f_s = fraction of stone meteorites which can penetrate the target,

f_i = fraction of iron meteorites which can penetrate the target,

A = target area (80 x 12 ft),

S = spacing factor.

It is assumed that burstered munitions will detonate when struck by a meteorite. Fire is also expected to occur. Details of the calculations are given in Ref. 7-5.

Sequence P07 - Meteorite Strikes the UPA

In this sequence the meteorite has to penetrate the 6-in. thick concrete roof of the MDB, the onsite container, and the munition itself. The same approach described in P06 is used here. Quantification details are provided in Ref. 7-5.

Sequence P07A - Meteorite Strikes the TOX

The TOX is located in the first floor of the MDB. The ceiling of the TOX is a minimum 12-in. thick. This is the most likely area vulnerable to a meteorite strike. Detailed calculations presented in Ref. 7-5 indicate that either a 200-lb stone meteorite or 20-lb iron meteorite can penetrate the TOX ceiling.

7.2.3. Aircraft Crashes

The aircraft crash-initiated accidents affecting the MHI and the MDB are similar to those affecting the storage igloos and warehouses. Both direct and indirect (i.e., adjacent to the building) crashes were considered. The aircraft crash may or not result in a fire. Furthermore, the ability to contain the fire in the shortest time possible influences the severity of the accident.

The event trees developed are shown in Figs. 7-41 and 7-42. No preliminary screening could be performed until the actual aircraft crash frequencies at each site had been analyzed. However, once the accident frequencies were quantified, those which have freqencies of 10^{-10}/yr or less were not analyzed for the agent release quantities. The accident sequences that have been defined from the event trees are as follows:

P09 - Direct large aircraft crash onto the MHI; no fire.

P010 - Direct large aircraft crash onto the MHI; fire not contained in 0.5 h.

P011 - Direct large aircraft crash onto the MHI; fire contained in 0.5 h.

P012 - Direct large aircraft crash damages the MDB; no fire.*

P013 - Direct large aircraft crash damages the MDB; fire not contained in 0.5 h.*

P014 - Direct large aircraft crash damages the MDB; fire contained in 0.5 h.*

P015 - Indirect large aircraft crash damages the MHI; no fire.

P016 - Indirect large aircraft crash damages the MHI; fire not contained in 0.5 h.

P017 - Indirect large aircraft crash damages the MHI; fire contained in 0.5 h.

P018 - Indirect large aircraft crash damages the MDB; no fire.*

P019 - Indirect large aircraft crash damages the MDB; fire not contained in 0.5 h.*

P020 - Indirect large aircraft crash damages the MDB; fire contained in 0.5 h.*

P021 - Large and small aircraft direct crash damages the outdoor agent piping system at TEAD; no fire.

P022 - Large and small aircraft direct crash damages the outdoor agent piping system at TEAD; fire occurs and not contained.

---

*Does not include effects of crash on outdoor piping sytem of the modified CAMDS facility at TEAD, which is considered separately.

7.2.3.1. <u>Aircraft Crash Accident Analysis</u>. In summary, the following general assumptions were made in deriving the large/small aircraft accident sequences:

1. For a large aircraft crash onto burstered munitions, it is assumed that detonations will occur for direct hits; only rockets and mines detonate from indirect hits; and, if a fire occurs, it is uncontained.

2. No small aircraft crashes were assumed to be able to sufficiently damage the MHI or the MDB to cause agent releases.

3. The vulnerability of the outdoor agent piping system at the modified CAMDS bulk facility (TEAD) was analyzed separately.

<u>Direct Large Aircraft Crash Onto the MHI/MDB; No Fire (P09, P012)</u>

Only large aircraft crashes have been found to significantly damage the MDB or the MHI. For a direct aircraft crash, the target area is the surface area of the building. Even if the crash does not lead to a fire, the impact of the crash is strong enough to cause the detonation of burstered munitions. The transportation data presented in Ref. 7-8 indicate that 55% of all air crashes do not involve fires. Quantification details are provided in Ref. 7-5.

<u>Direct Large Aircraft Crash onto the MHI/MDB; Fire Not Contained in 0.5 h (P010, P013)</u>

The analysis of these sequences follows the same approach as P09 and P012. The transportation data indicate that 45% of all aircraft crashes result in fires.

The successful containment of the fire is defined here to be 0.5 h for nonburstered munitions. This time was selected based on the

thermal failure threshold data presented in Appendix F, which indicate that direct heating of ton containers for 36 min leads to hydraulic rupture. For burstered munitions in onsite containers, the thermal failure threshold is conservatively defined as 15 min, which is the package design criteria for an all engulfing fire. Since the Army policy is not to fight a fire involving direct heating of burstered munitions, the probability of the "not containing the fire in 0.5 h" event is essentially unity.

The amount of agent released from bulk containers subjected to aircraft crash fires depends on the ability to contain the fire. If fire is allowed to progress for more than 30 min, more containers will rupture. The approach for quantifying the probability of successful containment of an aircraft crash fire has been discussed in Section 5.

Direct Large Aircraft Crash onto the MHI; Fire Contained in 0.5 h (P011, P014)

These scenarios essentially apply to nonburstered munitions only. If an airplane crashes directly onto the MHI or MDB containing non-burstered munitions, it is expected that every means available will be employed to terminate the fire immediately. The sooner the fire is extinguished the fewer munitions will be subjected to thermal rupture. Although the munitions are stored in onsite containers they are only provided 15-min protection from an all engulfing fire. The approach for calculating the probability of containing the fire in 0.5 h or less has been discussed in P010. The quantification details are provided in Ref. 7-5.

Indirect Large Aircraft Crash onto MHI/MDB; No Fire (P015, P018)

For an indirect crash, the target area is determined by increasing all building perimeters by 200 ft. To determine the probability that

the building will be damaged by flying debris from an aircraft crash in the vicinity of the building, the following assumptions were made:

1. The airplane can skid 100 ft and still damage the MHI.
2. The airplane can skid 150 ft and still damage the MDB.
3. 10% of all crashes are directed towards the igloo door.
4. 25% of all crashes are directed towards the MDB (i.e, either the TOX or the UPA may be hit).

For the MHI, the total probability of an aircraft part damaging the munition in containers is the sum of the probability that the missile will rupture the structure (including the munition at its line of sight) and the probability that the door is open at the time of the crash and the missile enters the open door and hits the munitions.

The probability that the missile will rupture the structure and the munitions is calculated as follows:

$$P_i = 0.10 \times A_i/A_{LA} \quad , \qquad (7\text{-}3)$$

where A_i = the area of the crash that could damage the igloo door if closed,

A_{LA} = the target area for an indirect large aircraft crash.

The SAI study (Ref. 7-4) indicates that the igloo door may be open 1% of the time. Since only 10% of all crashes are directed towards the door, the probability that the door is open and missile hits the munition through the open door is 0.001.

For the MDB, it is assumed that the either the TOX or the UPA may be the most vulnerable to a missile strike. Assuming that there was a

25% chance of the airplane crashing towards the TOX or the UPA, the probability of damaging the TOX or UPA is:

$$P_t = 0.25 \times A_t/A_{LA} \quad , \tag{7-4}$$

where A_t = the area of crash capable of damaging the TOX or UPA,
A_{LA} = the target area for an indirect crash of a large aircraft.

Quantification details are provided in Ref. 7-5.

<u>Indirect Large Aircraft Crash Damages the MHI/MDB; Fire Not Contained in 0.5 h (P016, P019)</u>

The same approach discussed above is applied to the analysis of these scenarios.

<u>Indirect Large Aircraft Crash Damages the MHI/MDB; Fire Contained in 0.5 h (P017, P020)</u>

The same approach discussed above is applied to the accident frequency analysis of these scenarios. This scenario applies to non-burstered munitions only based on the discussion of scenario P011.

<u>Aircraft Direct Crash Damages the Outdoor Agent Piping System at TEAD; No Fire (P021, P022)</u>

The present CAMDS facility at TEAD which will be modified to process bulk items only will have a separate building housing the TOX and the LIC. The two buildings will be connected by a 330 ft agent piping system to allow transfer of agent from the bulk drain station to the TOX. This pipe may be damaged by a both a large and small aircraft. The consequence is the same for both large and small aircraft crashes, hence the total aircraft crash frequency is the sum of the large and small aircraft crashes.

7.2.4. Earthquakes

The earthquake-initiated accident affecting the MHI is not a credible event since the current plan is to store unstacked munitions in onsite transportation containers in the MHI. The igloo is known to withstand very high intensity earthquakes and the only possibility for an agent release is if the munitions were to fall on a probe and be punctured. Since munitions will be stored in cylindrical containers and will not be stacked, puncture is not possible.

Several areas within the MDB are sensitive to earthquakes in the sense that damage to any of these areas could lead to a significant agent release. The areas of concern are: (1) the UPA where up to six onsite containers may be present; (2) the toxic cubicle (TOX) which houses two agent collection tanks, one of which may be completely full at the time of an earthquake; (3) the ventilation duct; (4) the agent piping system from the bulk drain station (BDS) to the TOX and from the TOX to the liquid incinerator (LIC); and (5) the fuel lines which could break and be ignited by earthquake-initiated electrical sparks.

Figures 7-43 and 7-44 show the event trees developed to identify relevant accident sequences in the MDB involving nonburstered and burstered munitions, respectively. Many event sequences have been screened out from further analysis based on the screening criteria described previously.

The accident sequences which survived the initial screening and have been analyzed further are listed in Table 7-6. Several more sequences were finally screened out after some analysis were performed on the basis of the frequency screening criterion of 10^{-10}/yr.

7.2.4.1. Earthquake Accident Analysis. The earthquake intensity is usually given in terms of maximum acceleration (i.e., g-level). There

is an approximate relationship between the Modified Mercalli Intensity (MMI) scale and the g-level. For example, MMI of VIII is approximately equivalent to 0.15 to 0.30 g.

7.1.4.2. Releases from Earthquake-Induced Accidents in the MDB. Sequences P025 to P034 involve the earthquake-initiated events inside the MDB. Lower intensity earthquakes may keep the munitions in the UPA as well as the agent collection tanks in the TOX intact but could initiate a fire that could subsequently cause the thermal detonation or hydraulic rupture of munitions in the UPA. Otherwise, high intensity earthquakes could cause munitions in the UPA to fall and be punctured, damage the agent collection tanks and the piping system, and also cause fire/explosion due to fuel line breaks. The events modeled are discussed below.

Releases Involving Bulk Containers

1. Earthquake Occurs. The initiating event (Event 1) in Fig. 7-43 is earthquake occurrence while bulk containers are being processed. To simplify the event tree evaluation, Event 1 further restricts the earthquake intensity to an acceleration range from g_l to g_u. Seven ranges are considered:

   a. 0.15 g to 0.2 g.
   b. 0.2 g to 0.3 g.
   c. 0.3 g to 0.4 g.
   d. 0.4 g to 0.5 g.
   e. 0.5 g to 0.6 g.
   f. 0.6 g to 0.7 g.
   g. Greater than 0.7 g.

   Earthquakes below 0.15 g are not considered in the analysis because the damage probabilities associated with such tremors

is negligibly small. Detailed examinations of seismic ranges above 0.7 g are unnecessary for the MDB because earthquakes above 0.7 g have a probability of almost 1.0 of damaging the MDB. With respect to the TOX, its high seismic design criterion precludes earthquake damage at frequencies above 10^{-10}/yr (see Section 4). Since release scenarios with frequencies below 10^{-10}/yr require no detailed examination, a detailed event tree analysis of seismic ranges above 0.7 g is also unnecessary relative to releases from the TOX.

The initiating event frequency at each site is the site-specific frequency at which earthquakes in the range, g_l to g_u, occur multiplied by the fraction of all bulk containers processed at the site. (Note: since this is classified information, the final frequency results will be adjusted accordingly in the classified appendix.). For an annual risk above ~3 x 10^{-5}/yr, the initiating event frequencies were taken from Fig. 4-11.

2. <u>MDB Not Damaged by the Earthquake</u>. MDB damage is defined as any loss of the MDB's agent containment capability. This includes damage to the MDB confinement walls or the ventilation system. As long as the MDB containment capability is maintained, any agent release inside the MDB (e.g., a release from a punctured munition) results in no appreciable release to the environment. Event 2 damage probabilities are based upon a generic study of damage to structures designed to the UBC.

The MDB (including the pipes and ducts) is designed to meet UBC seismic standards which means that the building is designed with a factor of safety and should not fail given an earthquake of a certain magnitude, depending on the site's seismic zone location. The CONUS facilities are being

designed for a minimum of seismic zone 2 design earthquakes, even though some of the sites may be in seismic zone 1 (i.e., APG, PBA, PUDA, and UMDA). ANAD, LBAD, and NAAP are in seismic zone 2 while TEAD is in seismic zone 3. Thus, the MDB at TEAD is designed to meet seismic zone 3 earthquake standards while the rest of the sites are designed to meet seismic zone 2 standards. The design level for a UBC structure with concrete walls (such as the MDB) is 0.14 g for seismic zone 3 and 0.07 g for seismic zone 2. The design safety factor is generally equal to 2. More details on the failure probabilities are presented in Appendix C.

3. Earthquake Impact on Munition Integrity. The munitions in the UPA represent a significant agent inventory. Event 3 addresses whether the earthquake causes a release from any of these munitions. Puncture is the dominant munition failure mode. The puncture probability is the probability that the earthquake causes an unpacked munition to fall from the conveyor or while it is being placed on the conveyor (this probability is conditionally dependent on seismic intensity) and that the fallen munition strikes a probe of sufficient size and density to penetrate it (the probe penetration probability is a function of munition type, see Ref. 7-5).

   Packed munitions are not stacked in the UPA. Ancillary studies indicate that the probability that a packed (or palletized) munition falls or is knocked over and strikes a probe of sufficient size to penetrate it (including penetrating any intervening packing material) is negligibly small relative to the 10^{-10}/yr screening criterion. Thus, only single munition punctures are addressed in Fig. 7-44.

4. TOX Integrity Maintained. The TOX, which may contain up to 500 gal of agent, also represents a potentially significant

release source. To minimize the potential of a release, the TOX room, tanks, and piping are being designed to meet the more stringent NRC standards and can survive earthquakes that engender MDB damage. The design g-level has not yet been determined but the intent is to ensure that the TOX will withstand relatively high g-forces. The same criteria will be applied to all sites regardless of the seismic zone location. For this analysis, it is assumed that the TOX will be designed for a 1-g safe shutdown earthquake (SSE) at all sites.

The high TOX design criterion virtually assures that TOX integrity will be maintained after all but the strongest (i.e., greater than 1 g) earthquakes. In order to quantify this contention, it is necessary to extrapolate the seismic hazard model in Fig. 4-11 to higher acceleration levels. This extrapolation is depicted in Fig. 7-45. The extrapolation is conservative for two reasons:

a. Linear logarithmic extrapolation results in the seismicity models for contour levels 0.05 through 0.20 intersecting the contour level 0.40 curve. Since the seismic hazard of a geological region is directly related to the associated contour level value, it is unlikely that the seismicity model for a region with a low hazard (e.g., a 0.10 contour level) will intersect the seismicity model for a region with a larger seismic hazard (e.g., a 0.20 contour level).

b. Most seismologists now believe that there is a physical upper limit to the amount of seismic energy that the earth can transmit. Although this upper limit depends upon site specific geological characteristics, for the MDB sites being considered it is estimated that this upper limit restricts ground acceleration to a maximum

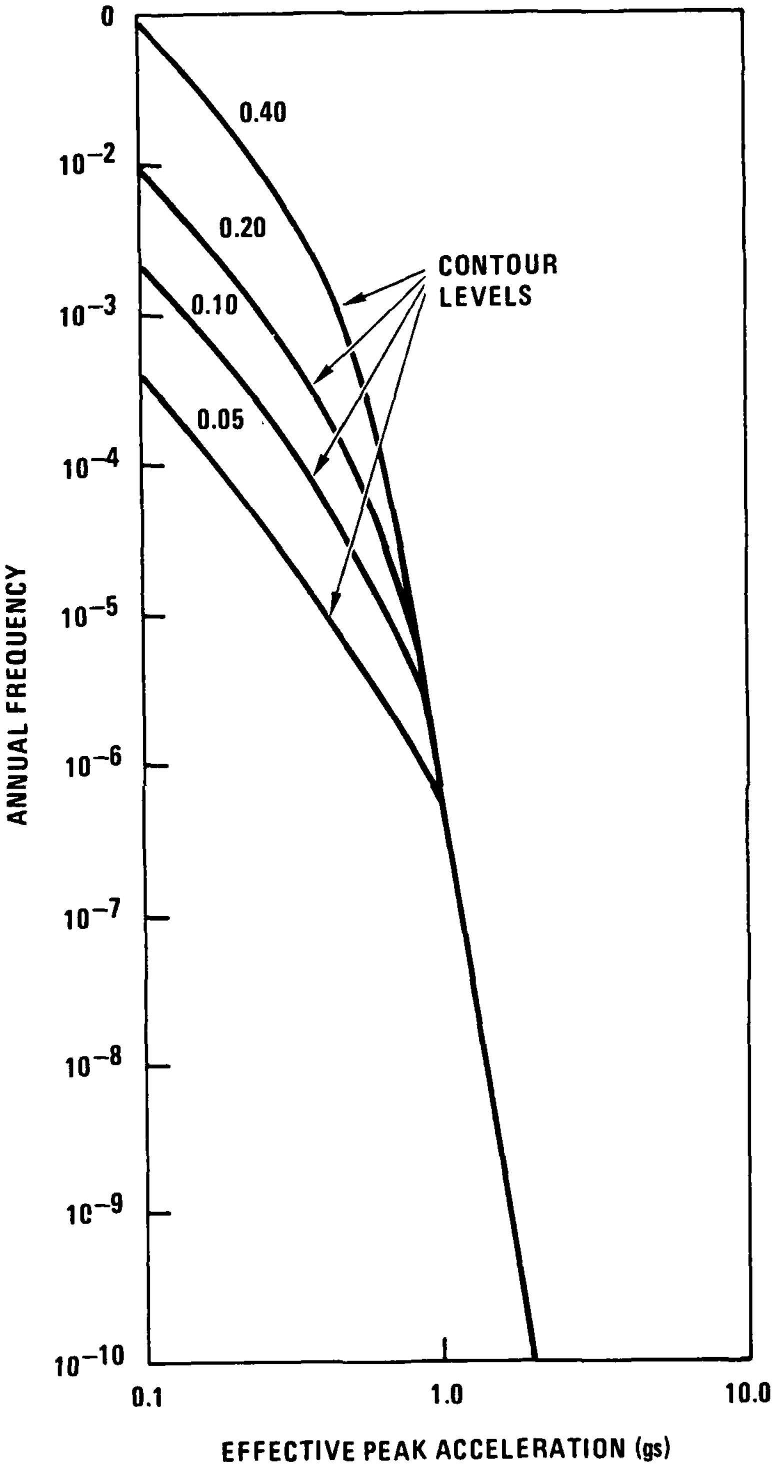


Fig. 7-45. Extrapolated seismic hazard model

value of around 0.6 to 0.8 g. Therefore, Fig. 7-45 is probably conservative by including effective peak accelerations above 0.8 g.

Figure 7-46 is the TOX fragility model corresponding to a 1 g SSE design (Appendix B includes the TOX fragility model derivation). By combining Figs. 7-45 and 7-46, it was determined that no event sequences involving TOX damage have a frequency of 10^{-10}/yr or greater.

5. Ignition Avoided. Available data indicate a high likelihood of earthquake-induced fires in both residential and commercial structures. Fig. 7-47 is the fault tree used to quantify the probability that an earthquake-initiated fire (or detonation) originates in the MDB.

Three mechanisms for ignition are identified. The first involves combustible material ignition by hot process equipment (e.g., a kiln or burner). Because of the high operating temperatures of this equipment, the ignition probability for Event X1 is essentially the probability that combustible material remains in contact with a hot surface long enough to ignite. If the MDB is not damaged by the earthquake the Event X1 probability is small relative to the probability of ignition from other mechanisms identified in Fig. 7-47. However, if the MDB is damaged by the earthquake, the Event X1 probability is essentially unity.

Natural gas ignition can result in either a fire or a detonation, depending upon the MDB integrity. If the MDB is intact, it is expected that detonation will result from a natural gas ignition. However, if the MDB is damaged by the earthquake, the buoyant natural gas cannot readily form a large detonable mass. Therefore, Fig. 7-47 models fire as the consequence of

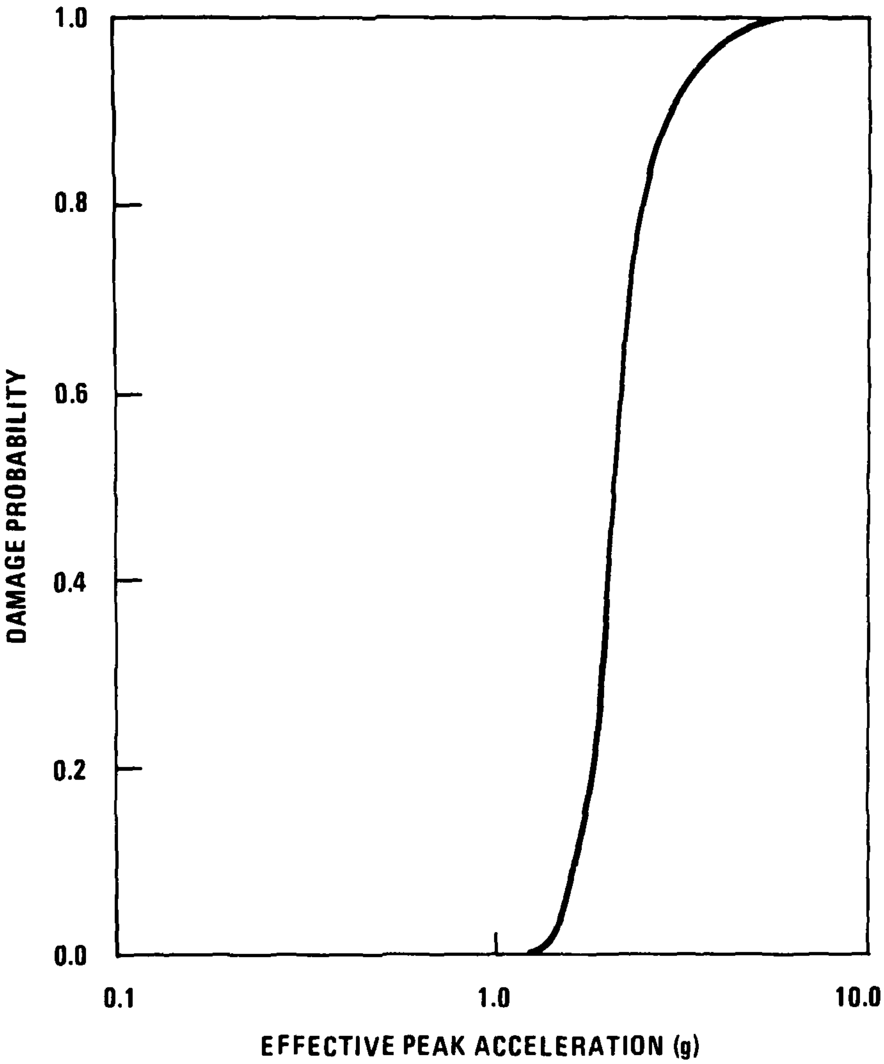


Fig. 7-46. TOX fragility model

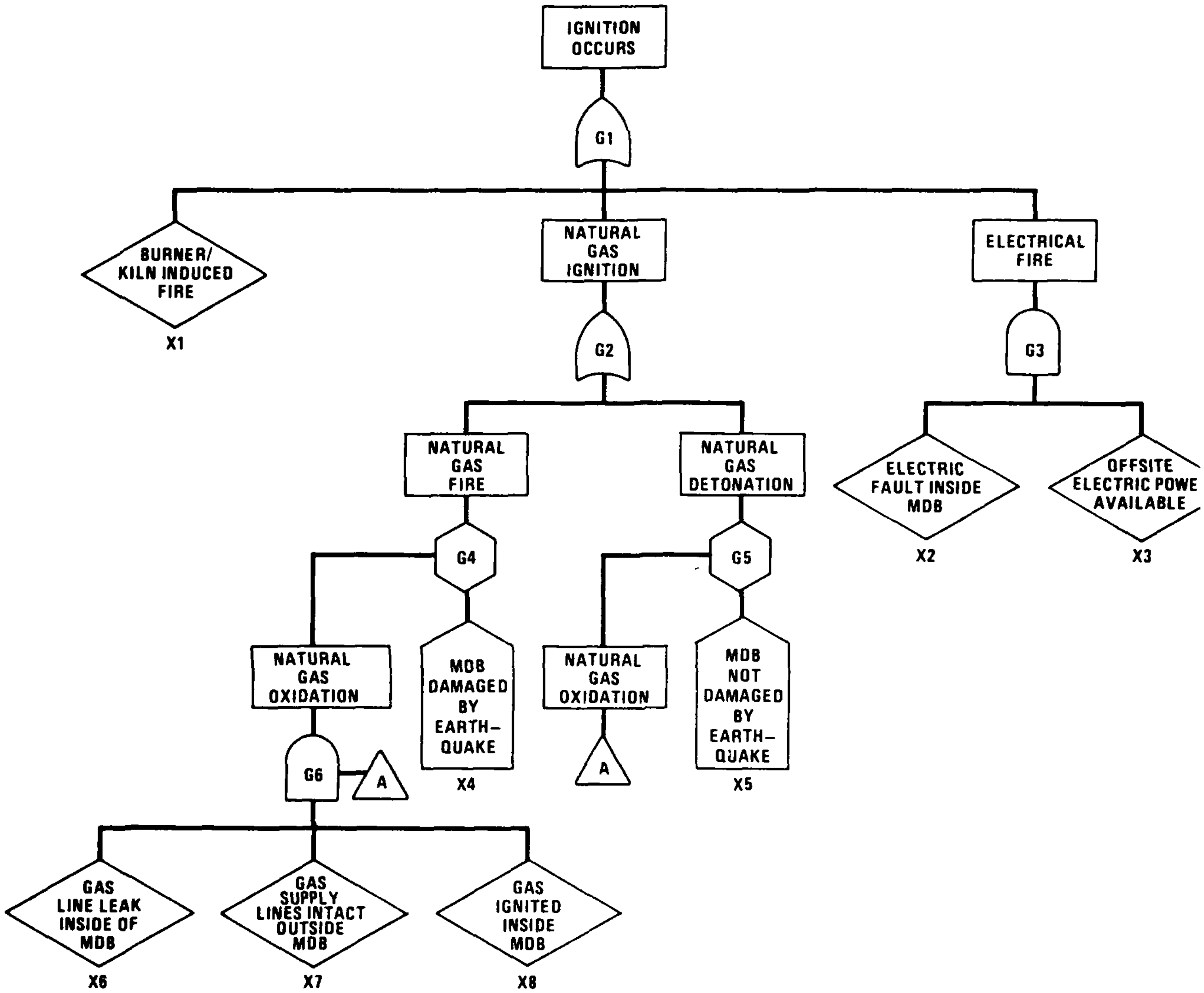


Fig. 7-47. Phenomenological fault tree for ignition occurrence

natural gas ignition when the MDB is damaged by the earthquake, and detonation as the consequence of natural gas ignition when the MDB is intact.

Three criteria must be satisfied for natural gas to ignite inside the MDB:

a. A natural gas line leak must occur inside the MDB.

b. A supply of natural gas must be available from the external distribution system.

c. An ignition source is required.

The third ignition mechanism addressed in Fig. 7-47 is an electrical fire. The conditions necessary for an electrical fire are:

a. An electrical fault (i.e., arcing) inside the MDB.

b. A supply of electric power to the faulted equipment.

Event X3 is an important factor in evaluation Fig. 7-47 because available data indicate that offsite power can be lost at a relatively low seismic intensity.

6. Fire Suppression Successful. Successful fire suppression is defined as extinguishing a fire before it increases the amount of agent available for release to the environment. The UPA and TOX are the major areas of concern. Since the TOX tank is vented, over pressurization is not a problem. Moreover, the temperatures produced by a fire are insufficient to directly fail the tank or agent piping. Hence, the principal concern is thermal failure of munitions in the UPA.

Fig. 7-48 is the fire suppression success tree. If the fire originates in the UPA (Event X1), 30 min are available to

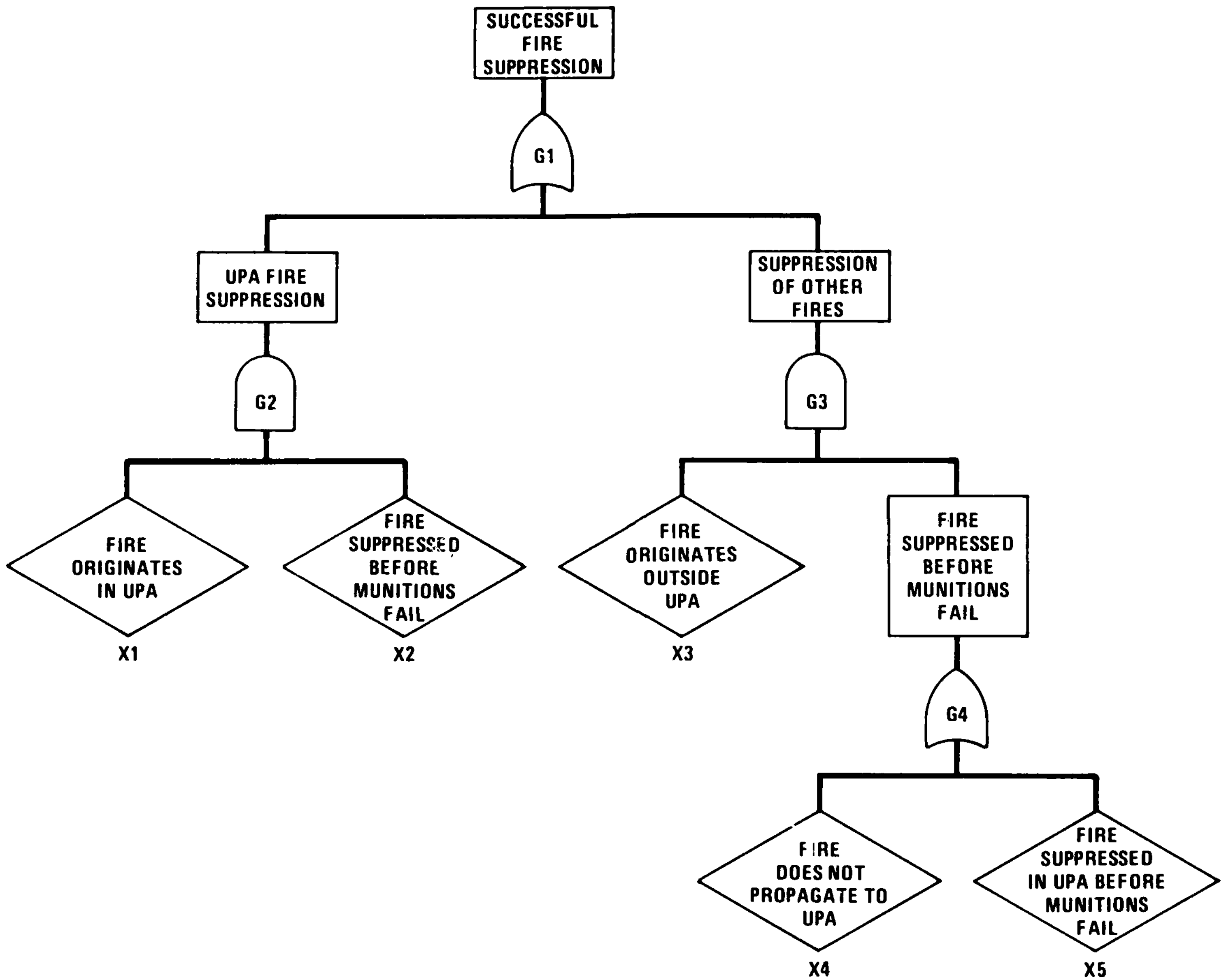


Fig. 7-48. Phenomenological success tree for fire suppression

suppress it before the bulk containers fail. If the MDB is intact (i.e., it has not been damaged by either the earthquake or a natural gas detonation), applicable data indicate a 76% chance of successfully suppressing the fire. If the MDB is damaged, the likelihood of suppressing a UPA fire within 30 min is effectively zero.

Fires that originate outside the UPA must propagate to the UPA and burn for 30 min before any bulk containers fail (Gate G3 in Fig. 7-48). If the MDB is intact, the fire walls preclude the propagation to the UPA. If the MDB is damaged by the earthquake, the probability of Event X4 is predicated upon extrapolating a fire propagation model developed for nuclear power plants, and is a function of the distance from the fire to the UPA. Finally, if the MDB is damaged by a natural gas detonation, successful fire suppression is conservatively ignored.

Event 6 is quantified with respect to whether the fire damages any containers in the UPA. However, if agent is released from the TOX, the dispersion mechanism is dependent upon agent combustion. Agent dispersion with combustion occurs only if any one of the following conditions is satisfied:

a. Natural gas detonation occurs.
b. The TOX and MDB are both damaged and a fire occurs.

<u>Releases Involving Burstered Munitions</u>

The salient differences between Figs. 7-43 and 7-44 relate to Events 1, 3, 5, and 6. The initiating event frequency (Event 1) in Fig. 7-34 is the site-specific frequency at which earthquakes in the range, g_1 to g_u, occur multiplied by the fraction of all munitions that

will be processed at the site that are burstered (this will be given in the classified appendix).

In addition to puncture, detonation is an important failure mode when burstered munitions are being processed (Event 3, Fig. 7-44). If the earthquake causes a munition detonation in the UPA, the probabilities of ignition and successful fire suppression (Events 5 and 6) are altered. Specifically, the conditional ignition probability is unity, subsequent to a munition detonation in the UPA. Moreover, a munition detonation in the UPA essentially precludes successful fire suppression. If the earthquake causes a fire but does not directly detonate any munitions, the fire suppression probability is quantified with the Fig. 7-12 success tree. However, the time available to suppress the fire is only 10 min for burstered munitions and there is no intervention from plant personnel or site fire fighters.

Uncertainties for the MDB earthquake events were evaluated as follows:

Event 1: Earthquake Occurs

The uncertainty in the initiating event frequency is represented by a lognormal distribution with an uncertainty factor of 10 and a median value equal to the point frequency estimate. This is predicated upon the generic guidelines issued for the uncertainty assessment (see Table 5-21).

Event 2: MDB Not Damaged by the Earthquake

Uncertainty factors for MDB damage probabilities above 0.1 will also be taken from Table 5-21. For failure probabilities below 0.1 an uncertainty factor of 3 is assigned. The uncertainty distribution in each case is lognormal with a median equal to the MDB failure probability.

Event 3: Earthquake Impact on Munition Integrity

Table 5-21 recommendations for probabilities of 0.1 or greater are applicable to the uncertainty in the probability that a munition falls from the conveyor. An uncertainty factor of 5 is applied to P_p - the conditional probability that a munition is punctured subsequent to a fall. Since all event sequences involving a munition detonation have frequencies below 10^{-10}/yr, they require no uncertainty analysis. The uncertainty distributions for the Event 3 parameters are lognormal with medians equal to the point probability estimates.

Event 4: TOX Integrity Maintained

Uncertainty factors for TOX damage probabilities above 0.1 will also be taken from Table 5-21. For failure probabilities below 0.1 an uncertainty factor of 3 is assigned. The uncertainty distribution in each case is lognormal with a median equal to the TOX failure probability.

Event 5: Ignition Avoided

The Event 5 uncertainty results from the uncertainties in the following functions and parameter.

1. f_{X2} (x) → probability density function for inside pipe failure.

2. f_{X3} (x) → probability density function for underground pipe failure.

3. Pr (X_4) → natural gas ignition probability.

4. f_{X5L} (x) → probability density function for light fixture failure.

5. f_{X5I} (x) → probability density function for industrial circuit failure.

6. f_{X6} (x) → probability density function for offsite power loss.

In general:

$$f_j (x) = \frac{1}{\beta_{R,J} \times \sqrt{2\pi}} \exp \frac{-[\ln(x) - \ln(\alpha_J \epsilon_{U,J})]^2}{2\beta^2_{R,J}}$$

Moreover, the uncertainty in each Event 5 fragility is a function of the uncertainty on $\epsilon_{U,J}$, as was described previously for warehouse fires. From Table 5-20, the uncertainty factors for $\epsilon_{U,X5L}$ and $\epsilon_{U,x6}$ are 2 and 1.5, respectively. Uncertainty factors for $\epsilon_{U,X2}$ and $\epsilon_{U,X5I}$ are from the Zion amd Seabrook PRAs. The value of $\epsilon_{U,X2}$ is directly applicable to the MDB, but the uncertainty factor for $\epsilon_{U,X51}$ is obtained from the Seabrook data plus an additional factor of 2 that arises from concerns about the applicability of a nuclear data base on the MDB design.

The major uncertainty in $\epsilon_{U,X3}$ is due to applying a generic Modified Mercalli fragility model to the MDB. Depending upon the actual soil conditions and pipeline characteristics, the median failure threshold can vary about the nominal value by a factor of 2. Thus, an uncertainty factor of 2 is adopted for $\epsilon_{U,X3}$.

Approximately a binominal distribution with a normal distribution, the uncertainty factor for Pr (X4) is 1.5. A lognormal distribution is modeled. These results are tabulated in Table 7-10.

<u>Event 6</u>: Fire Suppression Successful

The uncertainty in most fire suppression model functions and parameters (e.g., the probability of a pipe failure or loss of offsite

TABLE 7-10
EVENT 5 STATISTICAL PARAMETERS

Parameter	Median	Uncertainty Factor
$\epsilon_{U,X2}$	1	2.2
$\epsilon_{U,XE}$	1	2.0
Pr (X4)	0.0067	1.5
$\epsilon_{U,X5L}$	1	2.0
$\epsilon_{U,X5I}$	1	2.8
$\epsilon_{U,X6}$	1	1.5

power) was previously addressed for Event 5. Only three additional parameters require uncertainty models:

1. Operator error probability.
2. Damper failure probability.
3. Fire suppression failure probability.

According to information from Battelle-Columbus, the uncertainty in the operator error probability is lognormally distributed with an uncertainty factor of 10 and a median equal to the error probability. Data in EGG-EA5887 support a similar model for the damper failure probability. The fire propagation probability has a lognormal distribution with an uncertainty factor of 3 for fires originating outside of the UPA. For fire suppression inside the UPA the Table 5-21 guidelines are recommended. In both cases the nominal probabilities represent distribution medians.

7.2.4.3. Earthquake-Induced Releases Involving the Outdoor Agent Piping System at TEAD. The analysis of the earthquake scenarios involving the MDB for the modified CAMDS facility at TEAD includes the rupture of the agent piping system between the BDS and the TOX at TEAD. The agent pipe line is assumed to be double walled and approximately 330 ft long. The analysis also assumes that this pipe will be designed to NRC standards which means that the pipe should not fail at 1.0-g earthquake.

7.2.5. Quantification of Logic Models

The data base used for the quantification of the external event sequences are presented in Table 7-9 and in Tables 7-11 through 7-13.

7.2.5.1. Tornado Accident Frequencies. The data base used for the accident scenario analysis is listed in Table 7-9. The site-specific tornado frequency versus velocity curves have been presented in Section 4. Two types of missiles were initially considered: a (1) 3-in.

TABLE 7-11
DATA BASE FOR METEORITE INITIATED PLANT ACCIDENT SEQUENCES

24-Jul-87 Page 1

Data Base For Meteorite Initiated Plant Accident Scenarios

Event	Site	Munition / structure	Variable	Input Data	Error	Reference
1. Frequency of meteorite strike (events/sq-ft-yr)	All	All	METEOR	6.4E-13	1.0E+01	Ref. 7-8
2. Probability munition in igloo breached	All	Bomb	MEIB	2.4E-06	1.0E+01	See calc sheets (Ref. 7-3)
		4.2-in mort	MEID	1.6E-06		
		105-mm catrg	MEIC	9.7E-07		
		ton contnr	MEIK	3.3E-06		
		mine	MEIM	2.4E-06		
		155-mm proj	MEIP	7.4E-07		
		8-in proj	MEIQ	7.4E-07		
		rocket	MEIR	3.3E-06		
		sp. tank	MEIS	5.6E-06		
3. Probability munition in UPA breached	All	Bomb	MEUPB	7.9E-04	1.0E+01	See calc sheets (Ref. 7-3)
		4.2-in mort	MEUPD	5.5E-04		
		105-mm catrg	MEUPC	3.0E-04		
		ton contnr	MEUPK	1.1E-03		
		mine	MEUPM	7.9E-04		
		155-mm proj	MEUPP	2.4E-04		
		8-in proj	MEUPQ	2.4E-04		
		rocket	MEUPR	1.1E-03		
		sp. tank	MEUPS	1.8E-03		
4. Probability TOX is breached	All	All	METOX	1.2E-05	1.0E+01	Ref. 7-3
5. Probability outside agent pipe breached	TEAD	Pipe	MEPIPE	7.2E-02	5.0E+00	Ref 7-3
6. Target area (sq-ft)	All	Igloo	IGL	9.6E+02	none	Ref. 7-3
		UPA	UPA	5.7E+03	none	
		TOX	MDB	4.4E+04	none	
		Pipe	PIPE	6.6E+02	none	

TABLE 7-12
EFFECTIVE TARGET AREA FOR AIRCRAFT CRASH ANALYSIS

Effective Target Area (Sq-Mi) Direct Crash

SITE (B)	VARIABLE NAME (C)	AREA (SQ-MI) (D)
80-FT IGLOO	IGL80DR	7.60E-05
MDB	MDBDR	1.77E-03
CAMDS_PIPE	CDSPI	1.18E-03

Effective Target Area (Sq-Mi) Indirect Crash

SITE (B)	VARIABLE NAME (C)	AREA (SQ-MI) (D)
80-FT IGLOO	IGL80IR	7.26E-03
MDB	MDBIR	1.22E-02

TABLE 7-13
AIRCRAFT CRASH DATA

(O)	(P)	(Q)	(R)	(S)	(T)
DATA BASE FOR AIRCRAFT CRASH-INITIATED SCENARIOS FOR PLANT OPERATIONS					
EVENT	VARIABLE ID	FREQUENCY OR PROBABILITY	UNIT	ERROR FACTOR	REFERENCE
(O)	(P)	(Q)	(R)	(S)	(T)
1. Large aircraft crash (direct) onto MDB					
ANAD	LDAN	1.4E-08	per facility	10	Ref. 7-3
APG	LDAP	9.4E-10	yr	10	
LBAD	LDLB	8.0E-09		10	
NAAP	LDNA	8.1E-09		10	
PBA	LDPB	2.7E-09		10	
PUDA	LDPU	1.0E-07		10	
TEAD	LDTE	6.4E-10		10	
UMDA	LDUM	2.6E-08		10	
2. Large aircraft crash (indirect) onto MDB					
ANAD	LAAN	9.6E-08	per facility	10	Ref. 7-3
APG	LAAP	6.3E-07	yr	10	
LBAD	LALB	5.5E-08		10	
NAAP	LANA	5.6E-08		10	
PBA	LAPB	1.8E-08		10	
PUDA	LAPU	7.2E-07		10	
TEAD	LATE	4.4E-09		10	
UMDA	LAUM	1.8E-07		10	
3. Large aircraft crash (direct) onto MHI					
ANAD	DIAN	6.0E-10	per facility	10	Ref. 7-3
APG	DIAP	4.0E-11	yr	10	
LBAD	DILB	3.4E-10		10	
NAAP	DINA	3.5E-10		10	
PBA	DIPB	1.1E-10		10	
PUDA	DIPU	4.5E-09		10	
TEAD	DITE	2.7E-11		10	

TABLE 7-13 (Continued)

DATA BASE FOR AIRCRAFT CRASH-INITIATED SCENARIOS FOR PLANT OPERATIONS

EVENT	VARIABLE ID	FREQUENCY OR PROBABILITY	UNIT	ERROR FACTOR		REFERENCE
(O)	(P)	(Q)	(R)	(S)		(T)
UMDA	DIUM	1.1E-09			10	
4. Large aircraft crash (indirect) onto MHI						
ANAD	AIAN	5.7E-08	per facility		10	Ref. 7-3
APG	AIAP	3.8E-09	yr		10	
LBAD	AILB	3.3E-08			10	
NAAP	AINA	3.3E-08			10	
PBA	AIPB	1.1E-08			10	
PUDA	AIPU	4.3E-07			10	
TEAD	AITE	2.6E-09			10	
UMDA	AIUM	1.1E-07			10	
5. MDB breached given direct crash						
	BD	1.0E+00	none	none		EJ
6. MDB breached given indirect crash						
	BA	1.7E-01	none		2	Ref. 7-[illegible]
7. MHI breached given direct crash						
	ID	8.0E-01	none		1.4	EJ
8. MHI breached given indirect crash						
	IA	2.0E-03	none		5	Ref. 7-[illegible]
9. Crash does not involve fire						
	NF	5.5E-01	none	none		Ref. 7-6
13. Crash results in fire						
	YF	4.5E-01	none	none		Ref. 7-6
14. Fire not contnd in 1/2 hr (burstrd) direct crash						
	FNCB	1.0E+00	none	none		Ref. 7-[illegible]
15. Fire contnd in 1/2 hr (nonburstrd -direct and indirect)						
	FCNB	3.4E-04	none		3	Ref. 7-[illegible]

TABLE 7-13 (Continued)

DATA BASE FOR AIRCRAFT CRASH-INITIATED SCENARIOS FOR PLANT OPERATIONS

EVENT (O)	VARIABLE ID (P)	FREQUENCY OR PROBABILITY (Q)	UNIT (R)	ERROR FACTOR (S)	REFERENCE (T)
16. Fire not contnd in 1/2 hr (nonburstrd)	FNCNB	1.0E+00	none	none	Ref. 7-3
17. Aircraft crash onto outdoor pipe at CAMDS	LDCD	1.8E-08	none	10	Ref. 7-3

pipe and a (2) utility pole. For all munition types, it was found that the utility pole had a higher probability of penetrating munitions in the UPA and the igloo (with a steel door). Hence the data shown in Table 7-9 apply only to the cases where a utility pole was the missile. Also shown in the table are the error factors assigned to each variable. In many cases there was insufficient statistical information to adequately assess the data uncertainty and, therefore, the assignment of error factors was by engineering judgment. The results of the accident frequency analysis are presented in Table 7-14. All the accident scenarios were screened out on the basis of 1 x 10^{-10})/yr frequency criterion.

7.2.5.2. <u>Meteorite Strike Frequencies</u>. The data base used for the accident scenario analysis is presented in Table 7-11. More details on the derivation of these values are given in the calculation sheets (Ref. 7-5). The results of the accident frequency analysis are presented in Table 7-14. As indicated in the results, the frequencies of meteorite-initiated accidents for all scenarios are below 10^{-10}/yr and hence these scenarios have been screened out from further analysis.

7.2.5.3. <u>Aircraft Crash Frequencies</u>. The data used in the analysis of the aircraft crash accidents are presented in Tables 7-12 and 7-13. The derivation of the aircraft crash frequency values at each site has been discussed in Section 4. The results of the analysis are shown in Table 7-14. The following scenarios can be screened out on the basis of the 1.0 x 10^{-10}/yr:

P011 - Direct large aircraft crash onto the MHI; fire contained in 0.5 h.

P014 - Direct large aircraft crash onto the MDB; fire contained in 0.5 h.

P015 - Indirect large aircraft crash onto the MHI; no fire.

TABLE 7-14
PLANT OPERATIONS DATA

File: PLTCOL.WK1, 20-Aug-87 PAGE1

PLANT OPERATIONS COLLOCATION MEDIAN ACCIDENT FREQUENCY (PER YEAR)						PLANT OPERATIONS COLLOCATION MEDIAN ACCIDENT FREQUENCY (PER YEAR)	
SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
PO1 - Tornado-generated missile puncture/crush munitions in the MHI.							
FOBGC	1	N/A	--	1.5E-16	94	1.5E-16	94
FOBHC	1	[illegible]	94	1.3E-15	94	1.3E-15	94
FOCGC	1	2.1E-13	94	4.3E-16	94	4.3E-16	94
FOCHC	1	[illegible]	94	4.3E-16	94	4.3E-16	94
FOKGC	1	N/A	--	2.0E-16	94	2.0E-16	94
FOKHC	1	1.1E-13	94	2.0E-16	94	2.0E-16	94
FOKVC	1	1.1E-13	94	2.0E-16	94	2.0E-16	94
FOMVC	1	[illegible].5E-13	94	1.5E-15	94	1.5E-15	94
FOPGC	1	2.8E-13	94	5.7E-16	94	5.7E-16	94
FOPHC	1	2.8E-13	94	5.7E-16	94	5.7E-16	94
FOPVC	1	[illegible].6E-13	94	5.7E-16	94	5.7E-16	94
FOSGC	1	2.8E-13	94	6.3E-16	94	6.8E-16	94
FOSVC	1	N/A	--	6.8E-16	94	6.8E-16	94
FORSC	1	8.[illegible]E-13	94	1.4E-15	94	1.4E-15	94
FORVC	1	8.6E-13	94	1.4E-15	94	1.4E-15	94
FOSYC	1	N/A	--	3.7E-16	94	3.7E-16	94
PO2 - Tornado-generated missile detonate munitions in the MHI.							
FOBHC	2	1.7E-13	99	2.7E-16	99	2.7E-16	99
FOCGC	2	4.5E-14	99	9.1E-17	99	9.1E-17	99
FOCHC	2	4.5E-14	99	9.1E-17	99	9.1E-17	99
FOMVC	2	2.0E-13	99	3.2E-16	99	3.2E-16	99
FOPGC	2	6.0E-14	99	1.2E-16	99	1.2E-16	99
FOPHC	2	6.0E-14	99	1.2E-16	99	1.2E-16	99
FOPVC	2	[illegible].0E-14	99	1.2E-16	99	1.2E-16	99
FOSGC	2	[illegible].0E-14	99	1.5E-16	99	1.5E-16	99
FOSVC	2	N/A	--	1.5E-16	99	1.5E-16	99
FORGC	2	1.9E-13	99	3.0E-16	99	3.0E-16	99
FORVC	2	1.9E-13	99	3.0E-16	99	3.0E-16	99
PO3 - Tornado-generated missile puncture/crush munitions in the UPA.							

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 20-Aug-87 PAGE2

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD PDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
PCBBC	3	N/A	--	2.1E-15	94	2.1E-15	94
PCDHC	3	6.6E-12	94	7.9E-15	94	7.9E-15	94
PCCBC	3	2.3E-12	94	2.7E-15	94	2.7E-15	94
PCCHC	3	2.3E-12	94	2.7E-15	94	2.7E-15	94
PDKBC	3	N/A	--	3.6E-15	94	3.6E-15	94
PCKHC	3	3.6E-12	94	3.6E-15	94	3.6E-15	94
PCKVC	3	3.6E-12	94	3.6E-15	94	3.6E-15	94
PCMVC	3	6.0E-13	94	9.2E-15	94	9.2E-15	94
PDPGC	3	3.5E-12	94	4.1E-15	94	4.1E-15	94
PCPHC	3	3.5E-12	94	4.1E-15	94	4.1E-15	94
PDPVC	3	3.5E-12	94	4.1E-15	94	4.1E-15	94
PCIBC	3	3.5E-12	94	4.1E-15	94	4.1E-15	94
PC9VC	3	N/A	--	4.1E-15	94	4.1E-15	94
PCRBC	3	7.1E-12	94	8.5E-15	94	8.5E-15	94
PDRVC	3	7.1E-12	94	8.5E-15	94	8.5E-15	94
PCEVC	3	N/A	--	1.5E-14	94	1.5E-14	94
PC4 - Tornado-generated missile detonate munitions in the UPA.							
PCDHC	4	7.1E-13	94	8.4E-16	94	8.4E-16	94
PCCBC	4	2.4E-13	94	2.9E-16	94	2.9E-16	94
PCCHC	4	2.4E-13	94	2.9E-16	94	2.9E-16	94
PDMVC	4	1.3E-12	94	9.8E-16	94	9.8E-16	94
PCPGC	4	3.7E-13	94	4.4E-16	94	4.4E-16	94
PCPHC	4	3.7E-13	94	4.4E-16	94	4.4E-16	94
PCPVC	4	3.7E-13	94	4.4E-16	94	4.4E-16	94
PIBBC	4	3.7E-13	94	4.4E-16	94	4.4E-16	94
PCIVC	4	N/A	--	4.4E-16	94	4.4E-16	94
PCRBC	4	7.5E-13	94	4.4E-16	94	4.4E-16	94
PCTVC	4	0.0E+00	94	4.4E-16	94	4.4E-16	94
PC5 - Tornado-generated missile damages the agent piping system between the BDS and TOX at TEAD (bulk-only facility).							
PDABS	5	N/A	--	2.3E-11	94	2.3E-11	94

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 2[illegible]-Aug-87 PAGE[illegible]

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR
POAHS	5	N/A	--	0.0E+00	94
[illegible]	5	N/A	--	0.0E+00	94

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

TEAD NDC FREQ	RANGE FACTOR
0.0E+00	94
0.0E+00	94

Notes:

1. Frequency unit = events/operating year
2. Scenario 5 applies only to the TEAD bulk-only facility

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 20-Aug-87 PAGE1

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR
FO6 - Meteorite strikes the MHI.							
FOBGF	6	N/A	--	1.4E-15	26	1.4E-15	26
FODHC	6	9.8E-16	26	9.8E-16	26	9.8E-16	26
FOCBC	6	6.0E-16	26	6.0E-16	26	6.0E-16	26
FOCHC	6	6.0E-16	26	6.0E-16	26	6.0E-16	26
FOKGF	6	N/A	--	2.0E-15	26	2.0E-15	26
FOKHF	6	2.0E-15	26	2.0E-15	26	2.0E-15	26
FOKVF	6	2.0E-15	26	2.0E-15	26	2.0E-15	26
FOMVC	6	1.5E-15	26	1.5E-15	26	1.5E-15	26
FOPSC	6	4.6E-16	26	4.6E-16	26	4.6E-16	26
FOPHC	6	4.6E-16	26	4.6E-16	26	4.6E-16	26
FOPVC	6	4.6E-16	26	4.6E-16	26	4.6E-16	26
FOOGC	6	4.6E-16	26	4.6E-16	26	4.6E-16	26
FOSVC	6	N/A	--	4.6E-16	26	4.6E-16	26
FOFSC	6	2.1E-15	26	2.1E-15	26	2.1E-15	26
FOFVC	6	3.4E-15	26	2.1E-15	26	2.1E-15	26
FOSVF	6	N/A	--	3.4E-15	26	3.4E-15	26
FO7 - Meteorite strikes the UPA.							
FOBGF	7	N/A	--	2.9E-12	26	2.9E-12	26
FODHC	7	2.0E-12	26	2.0E-12	26	2.0E-12	26
FOCBC	7	1.1E-12	26	1.1E-12	26	1.1E-12	26
FOCHC	7	1.1E-12	26	1.1E-12	26	1.1E-12	26
FOKGF	7	N/A	--	4.0E-12	26	4.0E-12	26
FOKHF	7	4.0E-12	26	4.0E-12	26	4.0E-12	26
FOKVF	7	4.0E-12	26	4.0E-12	26	4.0E-12	26
FOMVC	7	2.9E-12	26	2.9E-12	26	2.9E-12	26
FOPSC	7	8.8E-13	26	8.8E-13	26	8.8E-13	26
FOPHC	7	8.8E-13	26	8.8E-13	26	8.8E-13	26
FOPVC	7	8.8E-13	26	8.8E-13	26	8.8E-13	26
FOOGC	7	8.9E-13	26	8.8E-13	26	8.8E-13	26

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 20-Aug-87 PAGE2

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
POQVC	7	N/A	--	8.8E-13	26	8.8E-13	26
POFGC	7	4.0E-12	26	4.0E-12	26	4.0E-12	26
POPVC	7	4.0E-12	26	4.0E-12	26	4.0E-12	26
POS.F	7	N/A	--	6.7E-12	26	6.7E-12	26
PO7A - Meteorite strikes the TOX.							
POAGF	7A	3.4E-13	26	3.4E-13	26	3.4E-13	26
POAHF	7A	3.4E-13	26	3.4E-13	26	3.4E-13	26
POA F	7A	3.4E-13	26	3.4E-13	26	3.4E-13	26
PO8 - Meteorite strikes the agent piping system between the BDS and TOX at TEAD (bulk-only facility).							
POAGF	8	N/A	--	3.0E-11	17	3.0E-11	17
POAHF	8	N/A	--	3.0E-11	17	3.0E-11	17
POAVF	8	N/A	--	3.0E-11	17	3.0E-11	17

Notes:

1. Frequency unit = events/operating year
2. Scenario 8 applies only to the TEAD bulk-only facility

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 20-Aug-87 PAGE1

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
F09 - Direct large aircraft crash onto the MHI; no fire							
FCGGS	9	N/A	--	1.2E-11	10	1.2E-11	10
F0DHC	9	2.6E-10	10	1.2E-11	10	1.2E-11	10
FCCGC	9	2.6E-10	10	1.2E-11	10	1.2E-11	10
P0CHC	9	2.5E-10	10	1.2E-11	10	1.2E-11	10
F0KGS	9	N/A	--	1.2E-11	10	1.2E-11	10
F0KHS	9	2.6E-10	10	1.2E-11	10	1.2E-11	10
F0KVS	9	2.6E-10	10	1.2E-11	10	1.2E-11	10
F0MVC	9	2.6E-10	10	1.2E-11	10	1.2E-11	10
F0PGC	9	2.6E-10	10	1.2E-11	10	1.2E-11	10
F0PHC	9	2.6E-10	10	1.2E-11	10	1.2E-11	10
F0PVC	9	2.6E-10	10	1.2E-11	10	1.2E-11	10
F0QGC	9	2.6E-10	10	1.2E-11	10	1.2E-11	10
F0QVC	9	N/A	--	1.2E-11	10	1.2E-11	10
F0RGC	9	2.6E-10	10	1.2E-11	10	1.2E-11	10
F0RVC	9	2.6E-10	10	1.2E-11	10	1.2E-11	10
F0SVC	9	N/A	--	1.2E-11	10	1.2E-11	10
F010 - Direct large aircraft crash onto the MHI; fire not contained in 0.5 hours							
F0BGF	10	N/A	--	9.8E-12	10	9.8E-12	10
F0DHC	10	2.2E-10	10	9.8E-12	10	9.8E-12	10
F0CGC	10	2.2E-10	10	9.8E-12	10	9.8E-12	10
F0CHC	10	2.2E-10	10	9.8E-12	10	9.8E-12	10
F0KGF	1	N/A	--	9.8E-12	10	9.8E-12	10
F0KHF	10	2.2E-10	10	9.8E-12	10	9.8E-12	10
F0KVF	1	2.2E-10	10	9.8E-12	10	9.8E-12	10
F0MVC	10	2.2E-10	10	9.8E-12	10	9.8E-12	10
F0PGC	10	2.2E-10	10	9.8E-12	10	9.8E-12	10
F0PHC	10	2.2E-10	10	9.6E-12	10	9.8E-12	10
F0PVC	10	2.2E-10	10	9.8E-12	10	9.8E-12	10
F0QGC	10	2.2E-10	10	9.8E-12	10	9.8E-12	10

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 20-Aug-87 PAGE2

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
PO2VC	10	N/A	--	9.8E-12	10	9.8E-12	10
PORGC	10	2.2E-10	10	9.8E-12	10	9.8E-12	10
POPVC	10	2.2E-10	10	9.8E-12	10	9.8E-12	10
POSVF	10	N/A	--	9.8E-12	10	9.8E-12	10
PC11 - Direct large aircraft crash onto the MHI; fire contained in 0.5 hours							
POBGF	11	N/A	--	3.3E-15	13	3.3E-15	13
PO.GF	11	N/A	--	3.3E-15	13	3.3E-15	13
POKHF	11	7.3E-14	13	3.3E-15	13	3.3E-15	13
POKVF	11	7.3E-14	13	3.3E-15	13	3.3E-15	13
POSVF	11	N/A	--	3.3E-15	13	3.3E-15	13
PC12 - Direct large aircraft crash damages the MDB; no fire							
POBGS	12	N/A	--	3.5E-10	10	3.5E-10	10
PODHC	12	7.7E-09	10	3.5E-10	10	3.5E-10	10
POCGC	12	7.7E-09	10	3.5E-10	10	3.5E-10	10
POCHC	12	7.7E-09	10	3.5E-10	10	3.5E-10	10
POKGS	12	N/A	--	3.5E-10	10	3.5E-10	10
POKHS	12	7.7E-09	10	3.5E-10	10	3.5E-10	10
POKVS	12	7.7E-09	10	3.5E-10	10	3.5E-10	10
POMVC	12	7.7E-09	10	3.5E-10	10	3.5E-10	10
POPGC	12	7.7E-09	10	3.5E-10	10	3.5E-10	10
POFHC	12	7.7E-09	10	3.5E-10	10	3.5E-10	10
POPVC	12	7.7E-09	10	3.5E-10	10	3.5E-10	10
POQGC	12	7.7E-09	10	3.5E-10	10	3.5E-10	10
POQVC	12	N/A	--	3.5E-10	10	3.5E-10	10
PORGC	12	7.7E-09	10	3.5E-10	10	3.5E-10	10
PORVC	12	7.7E-09	10	3.5E-10	10	3.5E-10	10
POSVS	12	N/A	--	3.5E-10	10	3.5E-10	10
PC13 - Direct large aircraft crash damages the MDB; fire not contained in 0.5 hours							
POBGF	13	N/A	--	2.9E-10	10	2.9E-10	10
PODHC	13	6.3E-09	10	2.9E-10	10	2.9E-10	10

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 20-Aug-87 PAGE3

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
POIGC	13	6.3E-09	10	2.9E-10	10	2.9E-10	10
POOHC	13	6.3E-09	10	2.9E-10	10	2.9E-10	10
POKGF	13	N/A	--	2.9E-10	10	2.9E-10	10
POKHF	13	6.3E-09	10	2.9E-10	10	2.9E-10	10
POKVF	13	6.3E-09	10	2.9E-10	10	2.9E-10	10
POMVC	13	6.3E-09	10	2.9E-10	10	2.9E-10	10
POPGC	13	6.3E-09	10	2.9E-10	10	2.9E-10	10
POPHC	13	6.3E-09	10	2.9E-10	10	2.9E-10	10
POPVC	13	6.3E-09	10	2.9E-10	10	2.9E-10	10
POQGC	13	6.3E-09	10	2.9E-10	10	2.9E-10	10
POQVC	13	N/A	--	2.9E-10	10	2.9E-10	10
PORGC	13	6.3E-09	10	2.9E-10	10	2.9E-10	10
PORVC	13	6.3E-09	10	2.9E-10	10	2.9E-10	10
POSVF	13	N/A	--	2.9E-10	10	2.9E-10	10
PO14 - Direct large aircraft crash damages the MDB; fire contained in 0.5 hours							
POBGF	14	N/A	--	9.7E-14	13	9.7E-14	13
POKGF	14	N/A	--	9.7E-14	13	9.7E-14	13
POKHF	14	2.1E-12	13	9.7E-14	13	9.7E-14	13
POKVF	14	2.1E-12	13	9.7E-14	13	9.7E-14	13
POSVF	14	N/A	--	9.7E-14	13	9.7E-14	13
PO15 - Indirect large aircraft crash damages the MHI; no fire							
POBGS	15	N/A	--	2.9E-12	13	2.9E-12	13
PODHC	15	6.3E-11	13	2.9E-12	13	2.9E-12	13
POOGC	15	6.3E-11	13	2.9E-12	13	2.9E-12	13
POOHC	15	6.3E-11	13	2.9E-12	13	2.9E-12	13
POIGS	15	N/A	--	2.9E-12	13	2.9E-12	13
POKHS	15	6.3E-11	13	2.9E-12	13	2.9E-12	13
POPVS	15	6.3E-11	13	2.9E-12	13	2.9E-12	13
POMVC	15	6.3E-11	13	2.9E-12	13	2.9E-12	13
POPGC	15	6.3E-11	13	2.9E-12	13	2.9E-12	13

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 20-Aug-87 PAGE4

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
PORHC	15	6.3E-11	13	2.9E-12	13	2.9E-12	13
PORVC	15	6.3E-11	13	2.9E-12	13	2.9E-12	13
POBSC	15	6.3E-11	13	2.9E-12	13	2.9E-12	13
POBVC	15	N/A	--	2.9E-12	13	2.9E-12	13
PORGC	15	6.3E-11	13	2.9E-12	13	2.9E-12	13
PORVC	15	6.3E-11	13	2.9E-12	13	2.9E-12	13
POSVS	15	N/A	--	2.9E-12	13	2.9E-12	13
PO16 - Indirect large aircraft crash damages the MHI; fire not contained in 0.5 hours							
POBGF	16	N/A	--	2.3E-12	13	2.3E-12	13
PODHC	16	5.2E-11	13	2.4E-12	13	2.4E-12	13
PODSC	16	5.2E-11	13	2.4E-12	13	2.4E-12	13
PODHC	16	5.2E-11	13	2.4E-12	13	2.4E-12	13
POVGF	16	N/A	--	2.3E-12	13	2.3E-12	13
PO-HF	16	5.1E-11	13	2.3E-12	13	2.3E-12	13
POVVF	16	5.1E-11	13	2.3E-12	13	2.3E-12	13
PONVC	16	5.2E-11	13	2.4E-12	13	2.4E-12	13
PORGC	16	5.2E-11	13	2.4E-12	13	2.4E-12	13
PORHC	16	5.2E-11	13	2.4E-12	13	2.4E-12	13
PORVC	16	5.2E-11	13	2.4E-12	13	2.4E-12	13
POBSC	16	5.2E-11	13	2.4E-12	13	2.4E-12	13
POBVC	16	N/A	--	2.4E-12	13	2.4E-12	13
PORSC	16	5.2E-11	13	2.4E-12	13	2.4E-12	13
PORVC	16	5.2E-11	13	2.4E-12	13	2.4E-12	13
POSVF	16	N/A	--	2.3E-12	13	2.3E-12	13
PO17 - Indirect large aircraft crash damages the MHI; fire contained in 0.5 hours							
POBGF	17	N/A	--	8.0E-16	16	8.0E-16	16
POVGF	17	N/A	--	8.0E-16	16	8.0E-16	16
PO-HF	17	1.8E-14	16	8.0E-16	16	8.0E-16	16
POVVF	17	1.8E-14	16	8.0E-16	16	8.0E-16	16
POSVF	17	N/A	--	8.0E-16	16	8.0E-16	16

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 29-Aug-87 PAGE5

PLANT OPERATIONS COLLOCATION MEDIAN ACCIDENT FREQUENCY (PER YEAR)						PLANT OPERATIONS COLLOCATION MEDIAN ACCIDENT FREQUENCY (PER YEAR)	
SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
P018 - Indirect large aircraft crash damages the MDB; no fire							
POBGS	18	N/A	--	4.0E-10	11	4.0E-10	11
PODHC	18	6.8E-09	11	4.0E-10	11	4.0E-10	11
POCGC	18	8.8E-09	11	4.0E-10	11	4.0E-10	11
POCHC	18	6.6E-09	11	4.0E-10	11	4.0E-10	11
POKGS	18	N/A	--	4.0E-10	11	4.0E-10	11
POKHS	18	6.8E-09	11	4.0E-10	11	4.0E-10	11
POKVS	18	8.8E-09	11	4.0E-10	11	4.0E-10	11
POMVC	18	6.8E-09	11	4.0E-10	11	4.0E-10	11
POPGC	18	6.9E-09	11	4.0E-10	11	4.0E-10	11
POPHC	18	8.8E-09	11	4.0E-10	11	4.0E-10	11
POPVC	18	8.8E-09	11	4.0E-10	11	4.0E-10	11
POQGC	18	9.6E-09	11	4.0E-10	11	4.0E-10	11
POQVC	18	N/A	--	4.0E-10	11	4.0E-10	11
PORSC	18	8.8E-09	11	4.0E-10	11	4.0E-10	11
PORVC	18	8.8E-09	11	4.0E-10	11	4.0E-10	11
POSVS	18	N/A	--	4.0E-10	11	4.0E-10	11
P019 - Indirect large aircraft crash damages the MDB; fire not contained in 0.5 hours							
POBGF	19	N/A	--	3.3E-10	11	3.3E-10	11
PODHC	19	7.2E-09	11	3.3E-10	11	3.3E-10	11
POCGC	19	7.2E-09	11	3.3E-10	11	3.3E-10	11
POCHC	19	7.2E-09	11	3.3E-10	11	3.3E-10	11
POKGF	19	N/A	--	3.3E-10	11	3.3E-10	11
POKHF	19	7.1E-09	11	3.3E-10	11	3.3E-10	11
POKVF	19	7.1E-09	11	3.3E-10	11	3.3E-10	11
POMVC	19	7.2E-09	11	3.3E-10	11	3.3E-10	11
POPGC	19	7.2E-09	11	3.3E-10	11	3.3E-10	11
POPHC	19	7.2E-09	11	3.3E-10	11	3.3E-10	11
POPVC	19	7.2E-09	11	3.3E-10	11	3.3E-10	11
POQGC	19	7.2E-09	11	3.3E-10	11	3.3E-10	11

AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF 6/13
THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO
CA A W BARSELL ET AL. AUG 87 GA-C-18563
UNCLASSIFIED SAPEO-CDE-IS-87008 DAAA15-85-D-0022 F/G 15/6.3 NL

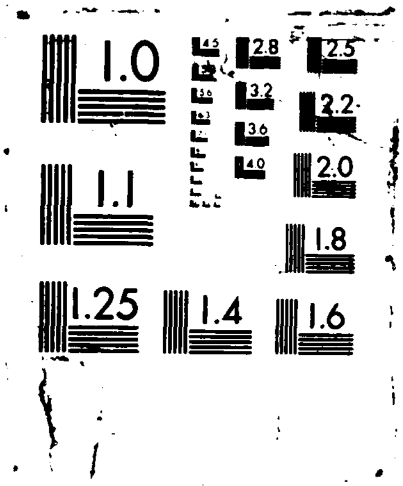

1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 20-Aug-87 PAGE6

PLANT OPERATIONS COLLOCATION MEDIAN ACCIDENT FREQUENCY (PER YEAR)						PLANT OPERATIONS COLLOCATION MEDIAN ACCIDENT FREQUENCY (PER YEAR)	
SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
POBVC	19	N/A	--	3.3E-10	11	3.3E-10	11
PORGC	19	7.2E-09	11	3.3E-10	11	3.3E-10	11
PORVC	19	7.2E-09	11	3.3E-10	11	3.3E-10	11
POSVF	19	N/A	--	3.3E-10	11	3.3E-10	11
PO20 - Indirect large aircraft crash damages the MDB; fire contained in 0.5 hours							
POBGF	20	N/A	--	1.1E-13	14	1.1E-13	14
POKGF	20	N/A	--	1.1E-13	14	1.1E-13	14
POKHF	20	2.4E-12	14	1.1E-13	14	1.1E-13	14
POKVF	20	2.4E-12	14	1.1E-13	14	1.1E-13	14
POSVF	20	N/A	--	1.1E-13	14	1.1E-13	14
PO21 - Large or small aircraft crash damages the outdoor agent piping system at TEAD; no fire							
POAGS	21	N/A	--	1.0E-08	10	1.0E-08	10
POAHS	21	N/A	--	1.0E-08	10	1.0E-08	10
POAVS	21	N/A	--	1.0E-08	10	1.0E-08	10
PO22 - Large or small aircraft crash damages the outdoor agent piping system at TEAD; fire occurs							
POAGS	22	N/A	--	8.2E-09	10	8.2E-09	10
POAHS	22	N/A	--	8.2E-09	10	8.2E-09	10
POAVS	22	N/A	--	8.2E-09	10	8.2E-09	10

Notes:

1. Frequency unit = events/operating year
2. Scenarios 21 and 22 apply only to the TEAD bulk-only facility

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 20-Aug-87 PAGE1

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
F025 - Earthquake damages the MDB structure, munitions fall & puncture; fire suppressed							
POBGC	25	N/A	--	1.9E-07	7	1.9E-07	7
POBHC	25	NEGL	--	NEGL	--	NEGL	--
POCGC	25	NEGL	--	NEGL	--	NEGL	--
POCHC	25	NEGL	--	NEGL	--	NEGL	--
POKGC	25	N/A	--	1.6E-06	7	1.6E-06	7
POKHC	25	7.1E-08	7	1.6E-06	7	1.6E-06	7
POKVC	25	7.1E-08	7	1.6E-06	7	1.6E-06	7
POMVC	25	2.3E-09	6	5.0E-08	7	5.0E-08	7
POPGC	25	NEGL	--	NEGL	--	NEGL	--
POPHC	25	NEGL	--	NEGL	--	NEGL	--
POPVC	25	NEGL	--	NEGL	--	NEGL	--
POQGC	25	NEGL	--	NEGL	--	NEGL	--
POQVC	25	N/A	--	NEGL	--	NEGL	--
PORGC	25	1.5E-08	6	3.3E-07	7	3.3E-07	7
PORVC	25	1.5E-08	6	3.3E-07	7	3.3E-07	7
POSVC	25	3.9E-07	7	8.4E-06	7	8.4E-06	7
F026 - Earthquake damages the MDB structure, munitions fall & puncture; earthquake initiates fire; fire suppression system fails.							
POBGC	26	N/A	--	6.1E-09	13	6.1E-09	13
POBHC	26	NEGL	--	NEGL	--	NEGL	--
POCGC	26	NEGL	--	NEGL	--	NEGL	--
POCHC	26	NEGL	--	NEGL	--	NEGL	--
POKGC	26	N/A	--	4.9E-08	13	4.9E-08	13
POKHC	26	1.8E-09	11	4.9E-08	13	4.9E-08	13
POKVC	26	1.8E-09	11	4.9E-08	13	4.9E-08	13
POMVC	26	NEGL	--	NEGL	--	NEGL	--
POPGC	26	NEGL	--	NEGL	--	NEGL	--
POPHC	26	NEGL	--	NEGL	--	NEGL	--
POPVC	26	NEGL	--	NEGL	--	NEGL	--
POQGC	26	NEGL	--	NEGL	--	NEGL	--

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 20-Aug-87 PAGE2

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
PDBVC	26	N/A	--	NEGL	--	NEGL	--
PORGC	26	4.0E-10	11	1.0E-08	14	1.0E-08	14
PORVC	26	4.0E-10	11	1.0E-08	14	1.0E-08	14
POSVC	26	N/A	--	2.7E-07	13	2.7E-07	13
PO29 - Earthquake damages the MDB; munitions are intact; fire occurs; fire suppression system fails.							
PCBGC	29	N/A	--	2.2E-05	10	2.2E-05	10
PCCHC	29	7.8E-07	9	2.2E-05	10	2.2E-05	10
PCCGC	29	7.8E-07	9	2.2E-05	10	2.2E-05	10
PCDHC	29	7.8E-07	9	2.2E-05	10	2.2E-05	10
PCKGC	29	N/A	--	2.2E-05	10	2.2E-05	10
POKHC	29	7.8E-07	9	2.2E-05	10	2.2E-05	10
POKVC	29	7.8E-07	9	2.2E-05	10	2.2E-05	10
POMHC	29	7.8E-07	9	2.2E-05	10	2.2E-05	10
POPGC	29	7.8E-07	9	2.2E-05	10	2.2E-05	10
PO--C	29	7.8E-07	9	2.2E-05	10	2.2E-05	10
POPVC	29	7.8E-07	9	2.2E-05	10	2.2E-05	10
POSGC	29	7.8E-07	9	2.2E-05	10	2.2E-05	10
PDBVC	29	N/A	--	2.2E-05	10	2.2E-05	10
PORGC	29	7.8E-07	9	2.2E-05	10	2.2E-05	10
PORVC	29	7.8E-07	9	2.2E-05	10	2.2E-05	10
POSVC	29	N/A	--	2.2E-05	10	2.2E-05	10
PO33 - Earthquake causes munitions to fall but no detonation occurs; the MDB is intact; the TOX is intact; earthquake initiates fire; fire supp							
PCBGC	33	N/A	--	N/A	--	N/A	--
PODHC	33	1.7E-06	20	4.8E-05	20	4.8E-05	20
PCCGC	33	1.7E-06	20	4.8E-05	20	4.8E-05	20
POCHC	33	1.7E-06	20	4.8E-05	20	4.8E-05	20
POKGC	33	N/A	--	N/A	--	N/A	--
POKHC	33	N/A	--	N/A	--	N/A	--
POKVC	33	N/A	--	N/A	--	N/A	--
POMVC	33	1.7E-06	20	4.8E-05	20	4.8E-05	20

TABLE 7-14 (Continued)

File: PLTCOL.WK1, 20-Aug-87 PAGE3

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR
POPGC	33	1.7E-06	20	4.8E-05	20	4.8E-05	20
POPHC	33	1.7E-06	20	4.8E-05	20	4.8E-05	20
POPVC	33	1.7E-06	20	4.8E-05	20	4.8E-05	20
POGGC	33	1.7E-06	20	4.8E-05	20	4.8E-05	20
POGVC	33	N/A	--	4.8E-05	20	4.8E-05	20
PORGC	33	1.7E-06	20	4.8E-05	20	4.8E-05	20
PORVC	33	1.7E-06	20	4.8E-05	20	4.8E-05	20
POSVC	33	N/A	--	N/A	--	N/A	--

Notes:

1. Frequency unit = events/operating year

P016 - Indirect large aircraft crash onto the MHI; fire not contained in 0.5 h.

P017 - Indirect large aircraft crash onto the MHI; fire contained in 0.5 h.

P020 - Indirect large aircraft crash onto the MDB; fire contained in 0.5 h.

There is very little distinction in the frequency of aircraft crashes with or without fire since the historical data indicate that there is only a 45% probability that an aircraft crash will involve a fire. The frequency of a crash onto the MDB is greater than the MHI because the surface area of the MDB is more than 100 times larger than the MHI.

For the regional collocation option, it is evident that large aircraft crashes occur more frequently at ANAD than TEAD. The frequency of an aircraft crash onto the outdoor agent piping system for the modified CAMDS facility is a dominant risk contributor. This scenario includes both large and small aircraft crashes and the frequency of small aircraft crashes (including helicopters) is at least two orders of magnitude higher than the frequency of large aircraft crashes at TEAD.

7.2.5.4. Earthquake-Induced Accident Frequencies. Reference 7-5 contains the frequency and failure probability data for each event modeled in the event trees that served as input data for the analysis of the accident scenario frequencies. The results of the frequency analysis are presented in Table 7-14. The earthquake accident frequencies for the scenarios analyzed are generally higher at TEAD since it is located in a more earthquake-prone region. Sequence P033, which postulates an earthquake-initiated munition fall and fire but with the MDB and TOX intact, has the highest frequency value (1.7×10^{-6}/yr for ANAD and 4.8×10^{-5}/yr for TEAD). This scenario involves the

detonation of all munitions (if burstered) in the UPA since fire is not suppressed. The agent release results are discussed in Section 10.

7.2.5.5. Uncertainty Analysis. The results of the uncertainty analysis indicate that the 95% percentile values may be 7 to 20 times higher than the reported median values. The uncertainties arise mainly from the general applicability of the raw data used to the perceived conditions of environment of a demilitarization program.

7.3. REFERENCES

7-1. Memorandum to C. A. Bolig, from R. Perry (OPMCM), May 6, 1987.

7-2. Swain, A. D., and H. E. Guttmann, "Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Application," Sandia National Laboratory, NUREG/CR-1278, August 1983.

7-3. Swain, A. D., "Accident Sequence Evaluation Program Human Reliability Procedure," Sandia National Laboratory, NUREG/CR-4772, February 1987.

7-4. Science Applications International Corporation, "Probabilities of Selected Hazards in Disposition of M55 Rockets," U.S. Army Toxic and Hazardous Materials Agency, M55-CS-2, November 1985.

7-5. "Supporting Calculations for the Risk Analysis of Chemical Munitions," GA Technologies, Inc., EPS-GA/DP-0092 (Issue 2), Volums 1, 2, and 3, August 1987.

7-6. Lawrence Livermore National Laboratory, "Explosives Handbook, Properties of Chemical Explosives and Explosive Simulants," March 16, 1981.

7-7. Solomon, K. A. , K. C. Erdmann, and D. Okrent, "Estimate of the Hazards to a Nuclear Reactor from the Random Impact of Meteorites," Nuclear Technology, Vol. 25, January 1975.

7-8. Clarke, R. K., et al., "Severities of Transportation Accidents," SLA-74-0001, Sandia National Laboratories, July 1976.

7-9. Telephone conversation C. Everline (GA Technologies) and R. Perry (OPMCM), June 15, 1987.

8. SCENARIO LOGIC MODELS FOR TRANSPORT

This section describes the development of accident scenarios for onsite (truck) transport at the originating and receiving sites, as well as offsite rail, air or marine transport from the storage site to the NDC or RDC disposal site. The work was performed by H&R Technical Associates, Inc. under subcontract to GA. The analysis covers only the transport in the hauling vehicle; risks associated with loading, unloading, and other handling activities are considered as part of the handling phase in Section 6. Risks while the munitions are in the holding area awaiting transport are treated in the storage phase analysis in Section 5.

Figure 8-1 shows a diagram of the transportation steps and options for the collocation disposal plan. As shown in the figure, there are three offsite carrier options: air, rail or marine transport. There are attendant differences in the sending/receiving site combinations. For example, marine shipment pertains only to transfer from APG to JACADS and air transfer is only for flights from the easternmost sites (APG and LBAD) to TEAD. Rail transport pertains to all combinations of nondisposal and disposal sites. There are additional attendant differences in the munitions package. Marine shipment pertains only to ton containers packed inside of vaults. For rail and air transport, the munitions are shipped in OFCs. For the last leg of truck transport from interim storage to the demil facility, the munitions are packed in ONCs.

Section 8.1 discusses logic models for accident scenarios during on-installation transport by truck to the offsite transporter (train, aircraft, or barge) or to the disposal plant. This phase is called "onsite transport," although it does not preclude the possibility that the railhead, air strip, or marine loading dock may be located outside

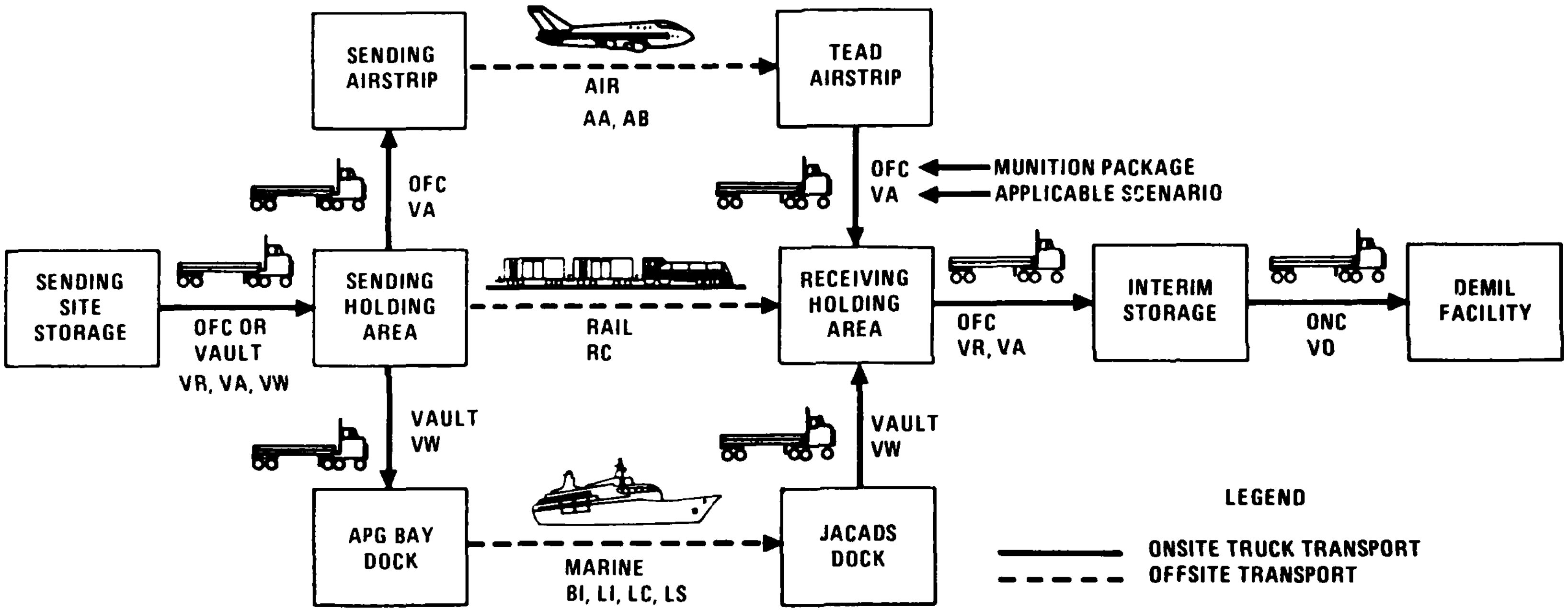


Fig. 8-1. Diagram of transportation steps and options (sending sites are APG for marine shipment, APG or LBAD for air transport, and all nondisposal sites for rail transport).

the sending or receiving site. Note that the onsite scenarios are developed in terms of risk per mile per site and they apply for all three offsite transport options. Differences lie in the number of operations involved in the offsite transfer options and because of site-specific data. Also, a different transport package is involved in the marine transport option, which affects the quantification.

Offsite transport is treated separately for the three modes of transport in Sections 8.2 to 8.4, since the respective accident scenarios differ fundamentally. Uncertainties for the transportation analyses in Sections 8.1 through 8.4 are discussed in Section 8.5.

Much of the basic data for rail and truck transport are given in Refs. 8-1 through 8-5. Details on the event tree branching probabilities are documented in the H&R Associates Inc. worksheets in Volume 3 of Ref. 8-6 for all onsite and offsite transportation. References 8-7 through 8-26 provide added sources of data.

The transportation accident analyses are consistent with the Army's plan for packaging and transport in Ref. 8-8. Administrative controls and procedures for transport are discussed in Section 3 and in Appendix G.

8.1. ONSITE TRANSPORT

8.1.1. Chronology of Operations

Figures 6-1 and 6-2 show flow diagrams of the handling and transport operations associated with the collocation options, including rail, air, or marine modes of offsite transport. This section analyzes onsite transport by truck for the following steps:

1. The munitions in OFCs (rail or air transport options) are taken by truck from their storage locations to the sending site holding area. For the marine transport case, the munitions are transported in vaults.

2. For the air transport mode, the OFCs are taken by truck from the holding area to an aircraft loading conveyor at the air strip. For rail transport, the holding area is at the railhead, so no truck transport is needed. For marine transport, the truck takes the vaults from the holding area to the barge loading dock.

3. At the destination, the munitions in their packages are placed in the receiving site holding area. For air transport, this is done by truck, from the air strip to the holding area. For rail, the holding area adjoins the railhead and no truck is needed.

4. For rail and air transport, the munitions, still in OFCs, are transported by truck from the receiving site holding area to the site's storage area (igloos, warehouse, or open area).

5. When ready for disposal, the munitions, now in ONCs, are trucked from storage to the MHI.

A generic set of accident sequences was developed (Section 8.1.3) which apply to each of these five transport steps. The set is designated as VR, VA, and VW for the rail, air, and marine offsite transport options, respectively, where they apply to the first four steps (first three steps for VW). In these steps, the munitions are always within the offsite packages (OFCs or vaults). For step 5, the munitions are trucked packaged within the ONC, so that quantification of the accident sequences is affected by the different package failure thresholds. For this step, the sequences are designated as VO, applicable for rail and air transport options only. Note that the accident sequence list and description is the same for VR, VA, VW, and VO. Only the resulting frequencies and/or agent releases differ.

8.1.2. Procedures and Assumptions

For this analysis it was assumed that all munitions for rail or air transport will be placed inside large OFC packages with outer dimensions of 20 x 8 x 8 ft (with failure thresholds as discussed in Section 3.3) prior to any offsite movement. For marine transport, the ton containers are in vaults which have similar failure thresholds as OFCs. It was also assumed that a 40-ft flatbed truck will be used as the transport vehicle. Each truck will carry one OFC or four vaults. Munition inventories for the OFC packages are shown in Table 10-3. A vault contains only one ton container. The munitions remain in these packages until arrival at the interim storage area of the disposal site. During the last transport leg, truck transport from interim storage to the MHI, the munitions are packed in ONCs, with four ONCs per truck. Each ONC contains one munition pallet (Table 10-3).

A standard distance of one mile was used for the distance between the storage area and the holding area at sending or receiving sites. This same distance was assumed for other truck transport legs, including to and from the air strip, to the marine dock, and from storage to the MHI.

The data base for truck accidents is discussed in Section 9.1.2, based largely on information in Refs. 8-1 through 8-5. A five-vehicle convoy will be used to transport munitions onsite. There is a lead security vehicle, one munition vehicle, a decontamination vehicle, an emergency vehicle, and a following security vehicle (Ref. 8-8). The small distance that the convoy travels, and the small number of trucks per convoy, make traffic control feasible to provide front, rear, and side collision protection. The major controls that affect the truck accident rate are:

1. No other movement activities or other activities which might pose a hazard to the munitions will be allowed to be carried out within 500 ft of the convoy route during munitions transport.

2. No fires external to the cargo and capable of challenging the package containment (i.e., an engulfing fire of 1850°F) will last longer than 10 min due to limits placed on the amount of truck fuel available.

3. Truck/train collisions are not credible because of the escort and the absence of train traffic during convoy movement.

4. No munitions movement will take place during periods of extreme weather conditions such as storms, tornado advisories, and blizzards, although a fully loaded truck may have to remain at rest during the bad weather.

Using this convoy model, several general assumptions can be made about the types of accidents that are possible:

1. Head-on collisions with a munitions vehicle are not credible.

2. Collisions in which a munitions vehicle rear-ends another vehicle are low-speed events limited by convoy speed.

3. Collisions in which a munitions vehicle hits a stationary object or overturns are low-speed events limited by convoy speed.

4. Collisions in which a munitions vehicle is rear-ended by another vehicle are low-speed events limited by convoy speed.

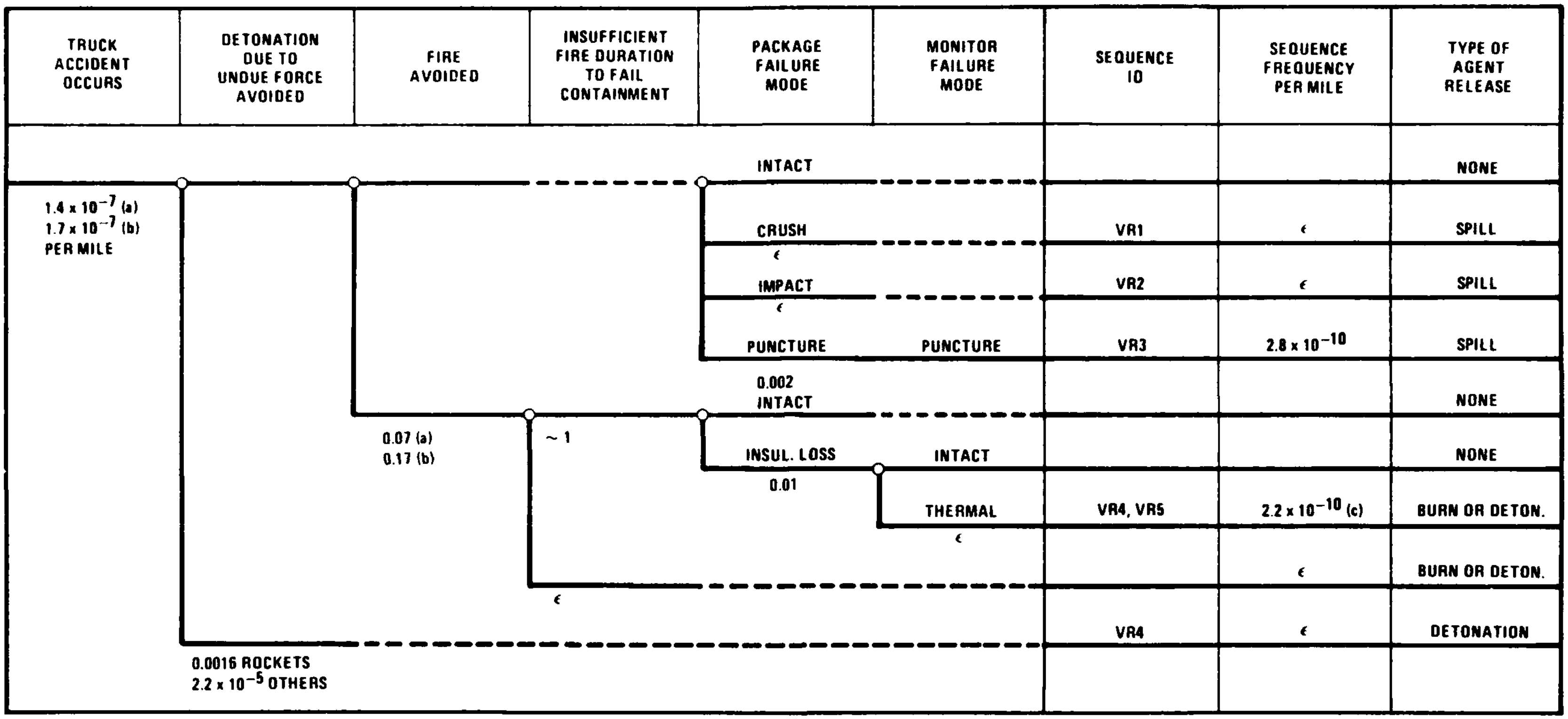
5. Collisions in which a munitions vehicle is struck from the side are not credible because of restrictions on other movement activities during convoy movement.

These assumptions limit the type of accident scenarios envisioned for local munition transport to truck collisions and overturns, spontaneous fires, and nonpreventable external events such as aircraft crashes, earthquakes, and tornadoes during transport.

8.1.3. Accident Scenarios for OFC and Vault Transport

Section 4.1 describes the logic for initiating event selection of onsite transport accidents. Table 4-4 shows four families of initiating events: (1) truck collision or overturn accident due to human error or equipment failure, (2) aircraft crash into the truck, (3) earthquake-induced collision or overturn, and (4) tornado-caused collision/overturn or missile impact. These four initiating event families were used to develop the scenario event trees as described in the subsections below.

8.1.3.1. Truck Collision/Overturn. Figure 8-2 shows the event tree for truck collision or overturn due to human error or mechanical failure. There are five important sequences resulting from this scenario,



(a) COLLISION/OVERTURN
(b) ALL TRUCK ACCIDENTS
(c) ROCKETS ONLY, ϵ FOR OTHER MUNITIONS

Fig. 8-2. Event tree for onsite transportation (truck accident)

differentiated by the types of force that could cause agent release (crush, impact, puncture, and fire). These are:

VR1 VA1 VW1	- A munitions vehicle collision/overturn occurs and crush forces fail the agent containment.
VR2 VA2 VW2	- A munitions vehicle collision/overturn occurs and impact forces fail the agent containment.
VR3 VA3 VW3	- A munitions vehicle collision/overturn occurs and puncture forces fail the agent containment.
VR4 VA4 (not applicable to the marine transport option)	- Detonation of burstered munitions occurs by either (1) fire only accident, (2) mechanical force and fire, (3) truck collision/overturn impact-induced rocket propellant ignition, or (4) truck collision/overturn induced undue force detonation.
VR5 VA5 VW5	- A munitions vehicle accident with fire occurs, causing nonburstered munitions to fail.

Note that the sequence coding beginning with VR denotes onsite transport for the rail shipment option, VA denotes onsite transport event for the air transport option and VW pertains to the marine shipment option (nonburstered munitions only). VO refers to truck transport to the disposal facility, which is analyzed separately in Section 8.1.4.

Data base information (Section 9.1.2) indicates that for generic highway accidents the rate is 2.5×10^{-6} collisions/overturns per mile. However, this rate is modified for the use of convoy and administrative controls (Table 9-7). The convoy speed will be selected so that the maximum velocity at which a collision or rollover involving a munitions vehicle can occur in convoy conditions is estimated to be no greater than 30 mph, even assuming gross driver error or mechanical failure (e.g., brakes) on a hill. Because the convoy is moving at low speed relative to highway traffic and under closely controlled conditions, the time allowed for driver response to threatening conditions is much greater at the lower speed, and collision-type accidents and overturn-

type accidents are more avoidable. Convoy accident frequencies have been decreased by a factor of 10 from highway accident frequencies because of greater driver awareness and control during convoy conditions. The probability of accidental collisions and overturns involving mechanical forces thus becomes 1.4×10^{-7} per mile. Mechanical force accident scenarios represent 83% of the total accidents expected.

Fires can break out in the cargo and in the vehicle without the occurrence of a mechanical force accident. The SNL standard highway frequency for this type of accident is 2.8×10^{-8} per mile. The use of convoy controls does not change the probability of a fire occurring, so the accident rate used for convoy traffic is unchanged. Fire-only scenarios represent 17% of the total accidents expected.

The probabilities of mechanical forces (crush, impact, and puncture) being generated in a truck accident were taken from Ref. 8-2, consistent with the failure criteria in Table 3-1. These values are consistent with the data in Ref. 8-3. The probability of an undue mechanical force causing burster detonation was derived from the truck velocity data in Ref. 8-1, assuming a log normal distribution with a 50% probability of detonation at 123 mph and a 10^{-6} probability at 13.5 mph (Ref. 8-6).

The probabilities of the top events of the event tree in Fig. 8-2 are discussed in Tables 8-1 through 8-5 for the munitions in OFCs or vaults for sequences 1 through 5 above. Sequence 1, 2, and 3 involve mechanical failure of the package by crush, impact force, and puncture, respectively. Fire, in conjunction with the crush, will cause different consequences (agent release) than mechanical failure without fire. The truck accident data base was examined by H&R Associates, Inc. to derive the fraction of truck collision/overturn accidents which are accompanied by fire. It was determined that 7% of the time a fire is also present. Thus, 93% of the time the consequence is an agent spill only; the remainder results in some unburned vapor release to the atmosphere.

TABLE 8-1
ONSITE TRANSPORT SEQUENCE 1

VR1 - A truck collision/overturn occurs in which the munitions are
VA1 subjected primarily to crush forces with other forces being
VW1 negligible. The agent release frequency is the product of three basic events: BE31, BE68, and BE73.

Event No.	Name	Probability	Reference/Remarks
BE31	Truck collision/ overturn	1.4×10^{-7} per mile	Table 9-7.
BE68	Crush force generated	0.05 VR, VA 1 VW	Reference 8-2.
BE73	Crush force fails agent containment	ϵ	The offsite package is designed to withstand an evenly distributed static crush load of 520,000 lb. The nonuniform static crush failure threshold is not known exactly, but is well above the maximum expected crush force of 15,000 lb (maximum crush load for a large package being transported by truck - Ref. 8-2).

TABLE 8-2
ONSITE TRANSPORT SEQUENCE 2

VR2 - A truck collision/overturn occurs in which munitions are
VA2 subjected primarily to impact forces with other forces being
VW2 negligible. The agent release frequency is the product of three basic events: BE31, BE60, and BE71.

Event No.	Name	Probability	Reference/Remarks
BE31	Truck collision/ overturn	1.4×10^{-7} per mile	Table 9-7.
BE60	Impact force generated	0.80 VR, VA 1 VW	Reference 8-2.
BE71	Impact force fails agent containment (>35 mph)	ϵ	The impact failure threshold for the package is 35 mph. The maximum postulated impact velocity in any accident is 30 mph, thereafter, the probability of agent release due to impact to zero, or very close to it, signified by epsilon (ϵ).

TABLE 8-3
ONSITE TRANSPORT SEQUENCE 3

VR3 - A truck collision/overturn occurs in which the munitions
VA3 are subjected primarily to puncture forces with other forces
VW3 being negligible. The agent release frequency is the product of three basic events: BE31, BE64, and BE67.

Event No.	Name	Probability	Reference/Remarks
BE31	Truck collision/ overturn	1.4×10^{-7} per mile	Table 9-7.
BE64	Puncture environment occurs	0.2 VR, VA 0.02 VW	Reference 8-2.
BE67	Probe fails agent containment (0.75 in. mild steel wall equivalent thickness)	0.01	Reference 8-2.

TABLE 8-4
ONSITE TRANSPORT SEQUENCE 4

VR4 - Detonation of builstered munitions by (1) fire-only accident,
VA4 (2) mechanical force and fire, (3) truck collision/overturn impact-induced rocket propellant ignition, or (4) truck collision/overturn induced undue force detonation. The release frequency is calculated by: (BE31) (BE62) (BE63) + (BE31A) (BE52') (BE62A) (BE63A) + (BE31A) (BE60) (BE61R) + (BE31A) (BE61). The third term is for rockets[a] only.

Event No.	Name	Probability	Reference/Remarks
BE31	Truck accident occurs	1.7×10^{-7} per mile	Table 9-7.
BE62	Fire generated	0.17	Table 9-7.
BE63	Fire has heat and duration to detonate burster (>2 h)	ϵ	Trucks limited to only enough fuel for the fire tc last 10 min.
BE31A	Truck collision/ overturn occurs	1.4×10^{-7} per mile	Table 9-7.
BE52'	Mechanical forces destroy package insulation	0.01	Reference 8-6.
BE62A	Fire occurs, given a collision or overturn	0.07	Reference 8-6.
BE63A	Fire has heat and duration to detonate burster (>30 min for degraded package)	ϵ	Trucks limited to only enough fuel for the fire to last 10 min.
BE60	Impact force generated	0.80	Reference 8-1.
BE61(R)	Impact force sufficient to detonate burster through propellant ignition	0.002	Reference 8-5.
BE61	Undue force detonation occurs	2.2×10^{-5}	Reference 8-6.

[a] Puncture-induced rocket propellant ignition has not been included because there is no evidence that a probe exists or could occur at the velocities necessary to cause puncture-induced propellant ignition. A 30-caliber bullet traveling about 1500 mph is required.

TABLE 8-5
ONSITE TRANSPORT SEQUENCE 5

VR5 - A truck accident occurs and a resulting fire fails non-
VA5 bursterered munitions. The agent release frequency is the
VW5 product of three basic events: BE31, BE62, and BE75, added
to the product of BE31A, BE52′, BE62A, and BE75A.

Event No.	Name	Probability	Reference/Remarks
BE31	Truck accident occurs	1.7×10^{-7} per mile	Table 9-7.
BE62	Fire occurs	0.17 VR, VA 0.02 VW	Table 9-7.
BE75	Thermal force fails agent containment (>2 h)	ϵ	Trucks are limited to carrying only enough fuel for a 10-min fire.
BE31A	Truck collision/ overturn occurs	1.4×10^{-7} per mile	Table 9-7.
BE52′	Mechanical forces destroy package insulation	0.01	Reference 8-6.
BE62A	Fire, given a collision	0.07	Reference 8-6.
BE75A	Thermal force fails agent containment inside degraded package (>30 min)	ϵ	Trucks are limited to carrying only enough fuel for a 10-min fire.

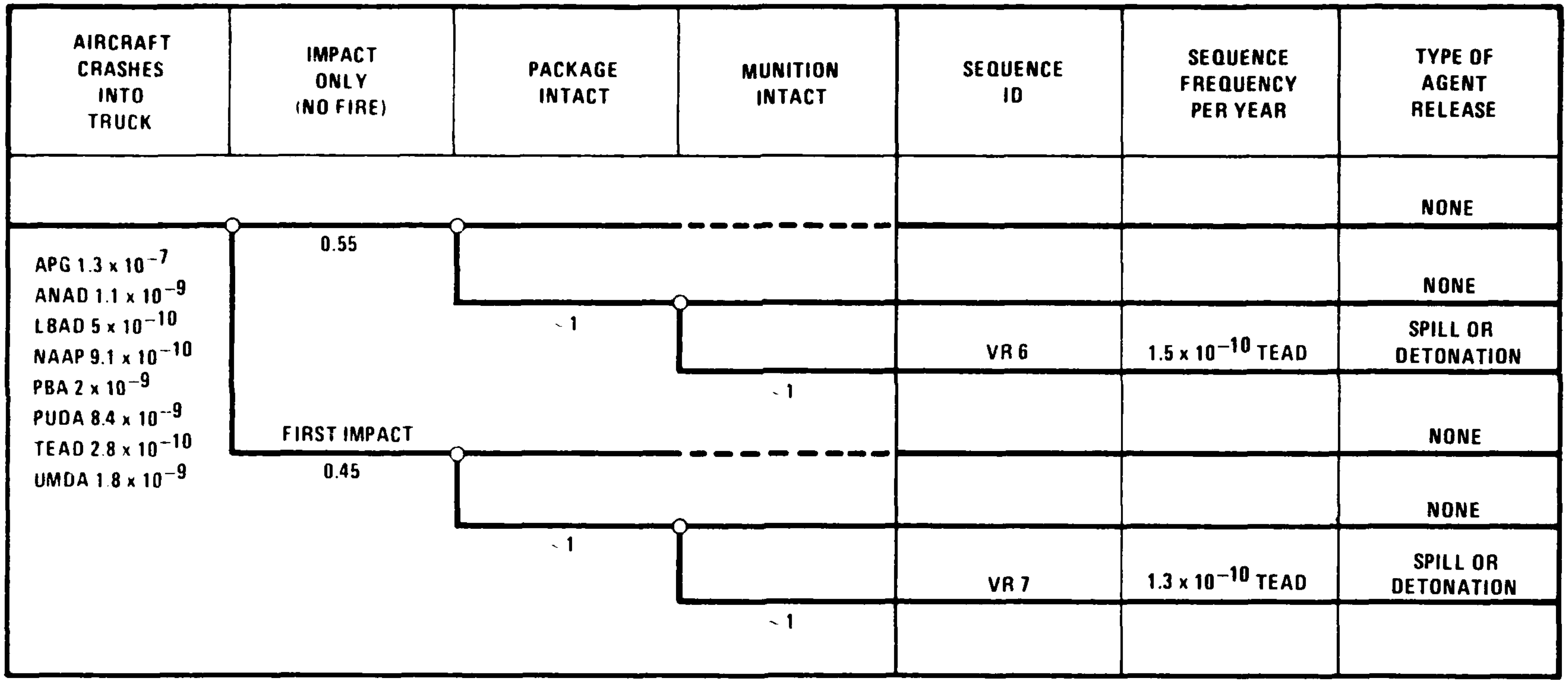
The results in Tables 8-1 through 8-5 show that sequences 1 and 2 can be screened out on the basis of low frequency due to the extremely low probabilities of mechanical failure by impact or crush. Sequence 3, involving mechanical failure by puncture, has a frequency of 3.8 x 10^{-10}/mile.

8.1.3.2. Aircraft Crash. Figure 8-3 shows the event tree for aircraft crash into a truck. The initiating event frequency is discussed and quantified in Section 4.2 in terms of number of crashes of small and large aircraft per year per unit area at each site (Table 4-7). Aircraft crash (large and small) values from Table 4-7 were modified to account for uncontrolled crashes and then multiplied by the truck cross-sectional area. An uncontrolled crash is defined as one where the impact angle is greater than 10 deg. It was assumed that for an aircraft to actually hit a truck, the crash would have to be uncontrolled. Modification consisted of multiplying the accident frequency contributions during takeoff, inflight and landing phases by the fraction of time that the crash has an impact angle greater than 10 deg for that phase (see Table 8-6).

An inherent assumption is that an accident involving an aircraft crashing onto a munitions vehicle more closely resembles the Sandia National Laboratory (SNL) model of a typical aircraft crash rather than the SNL model of a typical truck crash. In a typical SNL aircraft crash, the crush and puncture forces are negligible compared to the impact forces. Further details are available in Ref. 8-1.

There are two important accident sequences resulting from the aircraft crash event tree, sequences 6 and 7. These are described and quantified in Tables 8-6 and 8-7:

8.1.3.3. Earthquake. Figure 8-4 shows the event tree for the earthquake occurrence impact on onsite transport. Section 4.2 presents earthquake frequencies as a function of earthquake intensity and site. In this study, an earthquake intensity of 0.5 g is assumed to be needed



NOTE: INITIATING EVENT AND SEQUENCE FREQUENCIES ARE IN UNITS OF PER EXPOSURE YEAR.

Fig. 8-3. Event tree for onsite transportation (aircraft crash)

TABLE 8-6
ONSITE TRANSPORT SEQUENCE 6

VR6 - An aircraft crashes into a munitions truck; no fire results.
VA6 In aircraft accidents, the SNL data indicate that the predominant mechanical force employed against cargo packages is
VW6 impact, with crush and puncture having negligible effect. The agent release frequency is the product of three impact basic events: BE31, BE60, and BE71.

Event No.	Name	Probability	Reference/Remarks
BE31	Aircraft crash (per truck year)		
	APG	1.3×10^{-7}	Nine percent of all crashes are on takeoff, 32% inflight, and 58% on landing. Fifteen percent have impact angles greater than 10 deg in takeoff crashes, 70% in midflight crashes, and 13% in landing crashes (Refs. 8-6 and 8-7).
	ANAD	1.1×10^{-9}	
	LBAD	5×10^{-10}	
	NAAP	9.1×10^{-10}	
	PBA	2×10^{-9}	
	PUDA	8.4×10^{-9}	
	TEAD	2.8×10^{-10}	
	UMDA	1.8×10^{-9}	
BE60	Impact force only generated (no fire)	0.55	Derived from data in Ref. 8-1; 49% of all aircraft crashes involve impact with or without other forces; 27% of them are impact only; 0.27/0.49 = 0.55.
BE71	Impact force fails agent containment	1	Conservative value.

TABLE 8-7
ONSITE TRANSPORT SEQUENCE 7

VR7 - An aircraft crashes onto a munition truck, fire occurs but
VA7 impact forces fail agent containment. The agent release fre-
VW7 quency is the product of three basic events: BE31, BE60/62, and BE71.

Event No.	Name	Probability	Reference/Remarks
BE31	Aircraft crash (per truck year)		
	APG	1.3×10^{-7}	See remarks, sequence 6.
	ANAD	1.1×10^{-9}	
	LBAD	5×10^{-10}	
	NAAP	9.1×10^{-10}	
	PBA	2×10^{-9}	
	PUDA	8.4×10^{-9}	
	TEAD	2.8×10^{-10}	
	UMDA	1.8×10^{-9}	
BE60/62	Impact and fire generated	0.45	0.22/0.49 = 0.45 (fire and impact/all impact).
BE71	Impact force fails agent containment	1	Conservatively assumes that at least one package fails every time. Burstered munitions detonate. Nonburstered munitions release agent by spill and vapor.

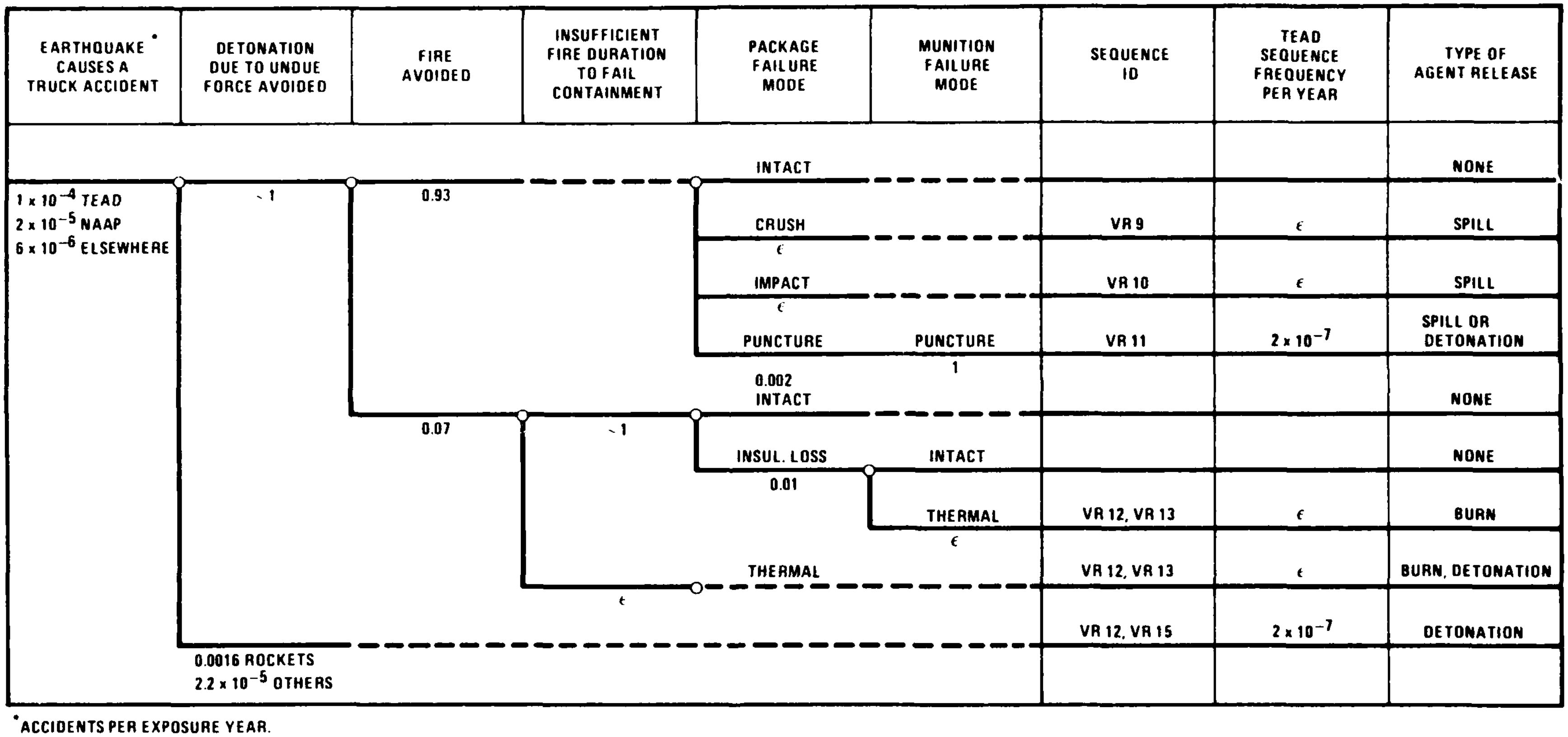


Fig. 8-4. Event tree for onsite transportation (earthquake)

to cause a truck collision or overturn. Thus, the initiating event frequency is taken to that for a 0.5 g earthquake or greater (called a "severe earthquake") at the specific site.

The following sequences resulted from the earthquake event tree analysis:

VR9 - A severe earthquake occurs, causing a munitions vehicle
VA9 accident, and crash forces fail the agent containment.
VW9

VR10 - A severe earthquake occurs, causing a munitions vehicle
VA10 accident, and impact forces fail the agent containment.
VW10

VR11 - A severe earthquake occurs, causing a munitions vehicle
VA11 accident, and puncture forces fail the agent containment.
VW11

VR12 - A severe earthquake occurs, causing a munitions vehicle
VA12 accident, and fire detonates burstered munitions.

VR13 - A severe earthquake occurs, causing a munitions vehicle
VA13 accident, and fire fails nonburstered munitions.
VW13

VR15 - An earthquake or tornado occurs, generating undue mechanical
VA15 forces which cause detonation of burstered munitions.

Note that sequence 15 has a dual initiator, either a severe earthquake or a tornado (analyzed in the next subsection). Quantification of the earthquake event tree is described in Tables 8-8 through 8-12.

8.1.3.4. Tornado. Figures 8-5 and 8-6 show the event trees for a tornado or high winds causing a truck collision overturn or generating an impacting missile. The tornado frequency is presented in Section 4.2 for the specific sites. Quantification of the event trees is summarized in Tables 8-13 through 8-15.

It is assumed that, given the high winds present during a tornado, and the high probability of accompanying rain, that a significant fire will not be initiated by the tornado, or sustained during the tornado. Therefore, fire sequences were not included in the tornado scenarios.

TABLE 8-8
ONSITE TRANSPORT SEQUENCE 9

VR9 - An earthquake occurs in which the munitions are subjected
VA9 primarily to crush forces with other forces being negligible.
VW9 The agent release frequency is the product of three basic events: BE31, BE68, and BE73.

Event No.	Name	Probability	Reference/Remarks
BE31	Earthquake occurs (per year)		
	TEAD	1×10^{-4}	Table 4-7; a ≥0.5-g earthquake
	NAAP	2×10^{-5}	is assumed. See Section 4.2.
	Elsewhere	6×10^{-6}	
BE68	Crush force generated	0.05 VR, VA 1 VW	Reference 8-2.
BE73	Crush force fails agent containment	ϵ	Same as sequence 1.

TABLE 8-9
ONSITE TRANSPORT SEQUENCE 10

VR10 - An earthquake occurs in which the munitions are subjected
VA10 primarily to impact forces with other forces being negli-
VW10 gible. The accident release frequency is the product of three basic events: BE31, BE60, and BE71.

Event No.	Name	Probability	Reference/Remarks
BE31	Earthquake occurs (per year)		
	TEAD	1×10^{-4}	Table 4-7; assumes ≥0.5-g earthquake.
	NAAP	2×10^{-5}	
	Elsewhere	6×10^{-6}	
BE60	Impact force generated	0.80 VR, VA 1 VW	Reference 8-2.
BE71	Impact force fails agent containment	ϵ	Same as sequence 2.

TABLE 8-10
ONSITE TRANSPORT SEQUENCE 11

VR11 - An earthquake occurs in which the munitions are subjected
VA11 primarily to puncture forces with other forces being negli-
VW11 gible. The agent release frequency is the product of three basic events: BE31, BE64, and BE67.

Event No.	Name	Probability	Reference/Remarks
BE31	Earthquake occurs (per year)		
	TEAD	1×10^{-4}	Table 4-7.
	NAAP	2×10^{-5}	
	Elsewhere	6×10^{-6}	
BE64	Puncture environment occurs	0.2 VR, VA 0.02 VW	Reference 8-2.
BE67	Probe fails agent containment	0.01	Reference 8-2.

TABLE 8-11
ONSITE TRANSPORT SEQUENCE 12

VR12 - An earthquake occurs and accidental forces cause detonation of burstered munitions. This sequence is similar to sequence VR4 and VR15. The agent release frequency is the product of three basic events: BE31, BE62, and BE63 added to the product of BE31, BE52′, BE62, and BE63A. The product of three propellant-ignition events: BE31, BE60, and BE61R is added to the result for rockets.[a]
VA12

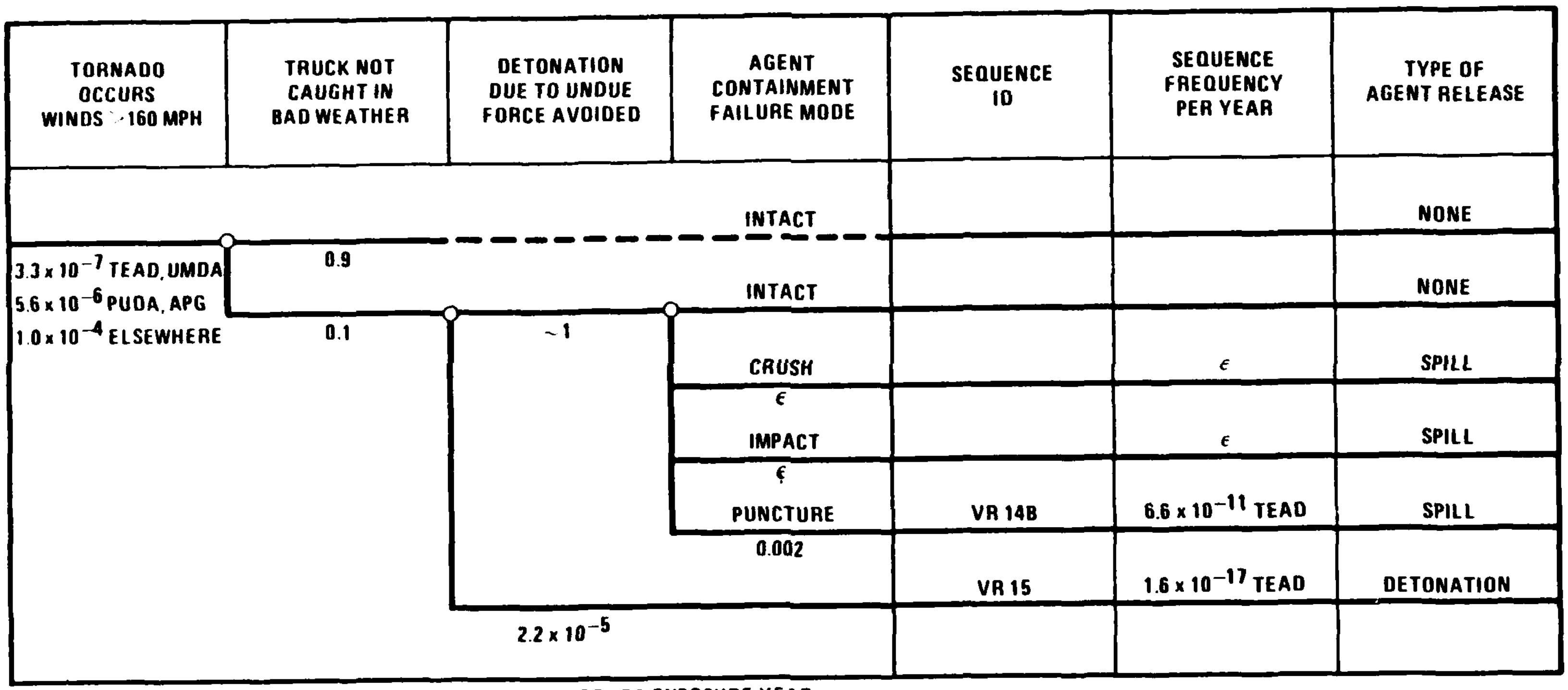
Event No.	Name	Probability	Reference/Remarks
BE31	Earthquake occurs (per year)		
	TEAD	1×10^{-4}	Table 4-7.
	NAAP	2×10^{-5}	
	Elsewhere	6×10^{-6}	
BE62	Fire generated	0.07	Reference 8-6.
BE63	Fire has heat and duration to detonate burster (>2 h)	ϵ	Trucks are limited to only enough fuel for a 10-min fire.
BE52′	Mechanical forces destroy package insulation	0.01	Reference 8-6.
BE63A	Fire has heat and duration to detonate burster for degraded package (>30 min)	ϵ	Trucks are limited to carrying only enough fuel for a 10-min fire.
BE60	Impact force generated	0.80	Reference 8-2.
BE61(R)	Impact force sufficient to detonate burster	0.002	Reference 8-2.

(a)Puncture-induced rocket propellant ignition has not been included because there is no evidence that a probe exists or could occur at velocities necessary to cause propellant ignition (30-caliber bullets traveling about 1500 mph are required).

TABLE 8-12
ONSITE TRANSPORT SEQUENCE 13

VR13 - An earthquake occurs and fire fails nonburstered munitions.
VA13 The agent release frequency is the product of three external
VW13 fire basic events: BE31, BE62, and BE75 added to the product of BE31, BE52′, BE62, BE75A.

Event No.	Name	Probability	Reference/Remarks
BE31	Earthquake occurs (per year)		
	TEAD	1×10^{-4}	Table 4-7.
	NAAP	2×10^{-5}	
	Elsewhere	6×10^{-6}	
BE62	Fire generated	0.07	Reference 8-6.
BE75	Thermal force fails agent containment (>2 h)	ϵ	Trucks are limited to only enough fuel for a 10-min fire.
BE52′	Mechanical forces destroy package insulation	0.01	Reference 8-6.
BE75A	Thermal force fails agent containment inside degraded package (>30 min)	ϵ	Trucks are limited to carrying only enough fuel for a 10-min fire.



NOTE: INITIATING EVENT AND SEQUENCE FREQUENCIES ARE PER EXPOSURE YEAR.

Fig. 8-5. Event tree for tornado-caused truck collision/overturn during onsite transportation

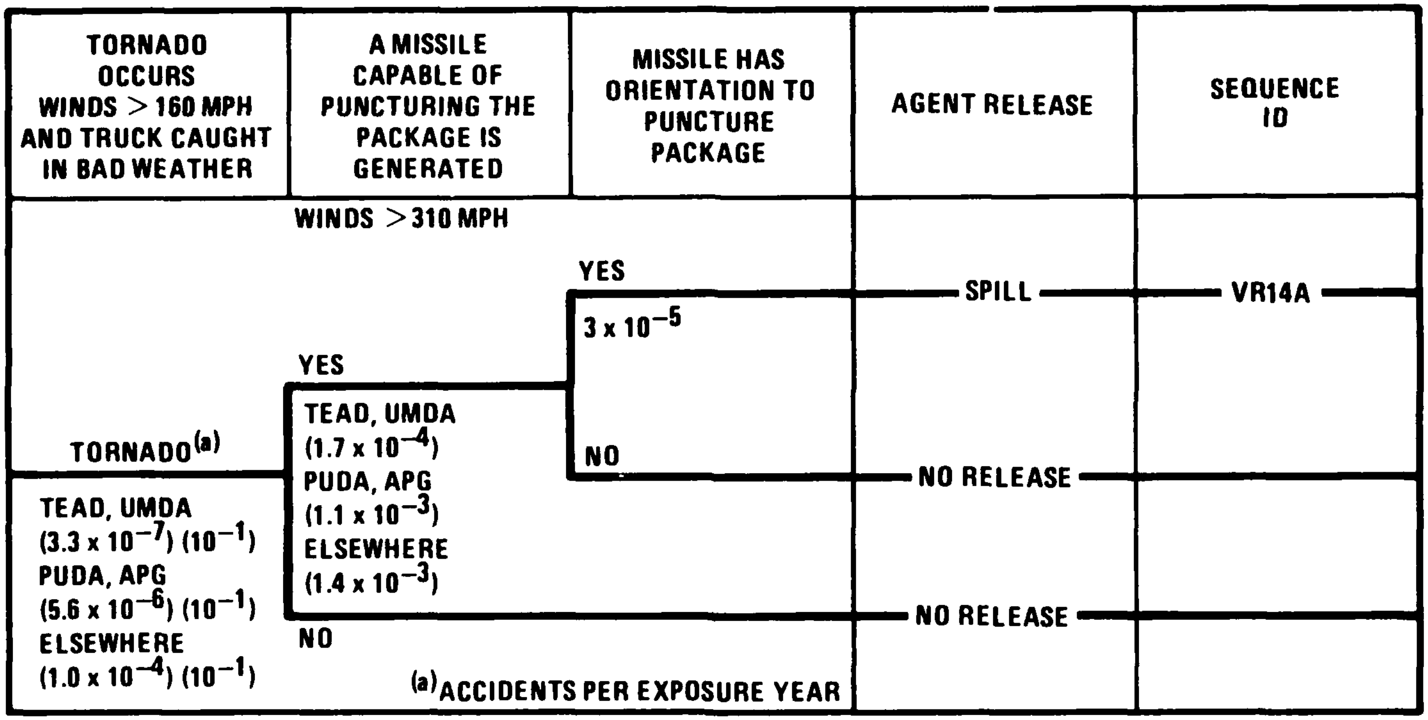


Fig. 8-6. Event tree for tornado-generated missile affecting onsite transportation

TABLE 8-13
ONSITE TRANSPORT SEQUENCE 14A

VR14A - Tornado-generated missile causes agent containment to fail.
VA14A The release frequency is the product of events BE31, BE31′,
VW14A BE64, and BE51.

Event No.	Name	Probability	Reference/Remarks
BE31	Tornado occurs (per year, winds >160 mph)		Site specific; see Section 4.2.
	TEAD, UMDA	3.3×10^{-7}	
	PUDA, APG	5.6×10^{-6}	
	Elsewhere	1.0×10^{-4}	
BE31′	Truck traveling in bad weather	0.1	Assumes a 10% chance that the administrative control prohibiting travel in bad weather will be violated.
BE64	Tornado-generated missile capable of puncturing and failing agent containment occurs (winds >310 mph)		Fraction of winds >160 mph that are also >310 mph. See Section 4.2 and Appendix C. Conservative for heavy-walled munitions.
	TEAD, UMDA	1.7×10^{-4}	
	PUDA, APG	1.1×10^{-3}	
	Elsewhere	1.4×10^{-3}	
BE51	Missile fails agent containment	3.0×10^{-5}	Methodology in Appendix C.

TABLE 8-14
ONSITE TRANSPORT SEQUENCE 14B

VR14B - Tornado causes a truck collision/overturn, generating
VA14B mechanical forces that fail agent containment. The release
VW14B frequency is calculated by: (BE31) (BE31′) (BE68) (BE53) + (BE31) (BE31′) (BE60) (BE52) + (BE31) (BE31′) (BE64A) (BE51A).

Event No.	Name	Probability	Reference/Remarks
BE31	Tornado occurs (per year, winds >160 mph)		See external events section.
	TEAD, UMDA	3.3×10^{-7}	
	PUDA, APG	5.6×10^{-6}	
	Elsewhere	1.0×10^{-4}	
BE31′	Truck traveling in bad weather	0.1	Assumes a 10% chance that the administrative control prohibiting travel during bad weather is violated.
BE68	Crush force generated	0.05 VR, VA 1 VW	Reference 8-2.
BE60	Impact force generated	0.80 VR, VA 1 VW	Reference 8-2.
BE64A	Puncture environment	0.2 VR, VA 0.02 VW	Reference 8-2.
BE53	Crush fails agent containment	ϵ	Maximum expected crush force equals 15,000 lb; Ref. 8-8.
BE52	Impact fails containment (>35 mph)	ϵ	Maximum postulated velocity change (30 mph) does not exceed package failure threshold of 35 mph.
BE51A	Probe fails agent containment (0.75 in. mild steel wall equivalent thickness)	0.01	Reference 8-2.

TABLE 8-15
ONSITE TRANSPORT SEQUENCE 15[a]

VR15 - An earthquake or tornado occurs, generating undue mechanical
VA15 forces which cause detonation of burstered munitions (types C, P, M, R). The release frequency is the product of events BE31 and BE61 added to the product of BE31A, BE31A′, and BE61.

Event No.	Name	Probability	Reference/Remarks
BE31	Earthquake occurs (per year)		
	TEAD	1×10^{-4}	See Section 4.2.
	NAAP	2×10^{-5}	
	Elsewhere	6×10^{-6}	
BE31A	Tornado occurs (per year)		
	TEAD, UMDA	3.3×10^{-7}	See Section 4.2.
	PUDA, APG	5.6×10^{-6}	
	Elsewhere	1.0×10^{-4}	
BE31A′	Trucks traveling in bad weather	0.1	Assumes a 10% probability that the administrative control prohibiting travel during bad weather is violated.
BE61	Undue mechanical force sufficient to detonate burster occurs	2.2×10^{-5}	Reference 8-6.

[a] Does not apply to marine shipment.

The following sequences resulted from the event tree analysis (Figs. 8-5 and 8-6): 14A, 14B, and 15. In 14A, a penetrating missile is generated. In 14B, the tornado causes a truck collision/overturn with mechanical failure of a package. For 14B, only the puncture failure mode was found to be significant (impact and crush failure are negligible). Thus, the frequencies of 14A and 14B were summed to form sequence 14, since the consequences were the same.

8.1.4. Accident Scenarios for ONC Transport

Transport of munitions in ONCs occurs during the last leg, from interim storage to the MHI at the disposal site (TEAD or ANAD). The structure of the accident event trees and the list of accident sequences is the same for this leg as for other onsite transport legs. However, quantification of the accident sequences differs because the ONC package has different failure criteria and thresholds compared to the OFC package (see Section 3.3). To distinguish the ONC transport, the sequences are denoted by V1 through V15. For the NDC option, they apply only to TEAD; for the RDC option, they apply to both TEAD and ANAD. Corresponding initiating event frequencies for external events at these specific sites are used.

There are three areas where conditional failure probabilities change from those in Section 8.1.3. These are mechanical failure (impact, crush or puncture), detonation of burstered munitions due to a fire, and tornado-generated missile puncture probability. All other branch probabilities are as described in Section 8.1.3.

For crush, the ONCs and munitions themselves can withstand a crush load to 50,000 lb (Table 3-1). Thus, compared to the negligible probability of crush for an OFC, the ONC package has nonnegligible crush failure probability estimated to be 0.1 based on data in Ref. 8-1 on the

load environment for a small package. This is the combined probability that the crush force is generated and that the force fails the containment.

For impact, the ONC failure threshold is 35 mph (Table 3-1), compared to the maximum impact velocity in any accident of 30 mph. Thus, the probability of agent release due to impact is close to zero, signified by ϵ, as it was for an OFC.

For puncture, ONC failure occurs at a velocity/radius threshold of 100/s, which is half that for the OFC package (Table 3-1). Based on information in Ref. 8-1, the probability that a puncture environment occurs during an accident is 0.016, while the probability that the probe fails the agent containment is 0.024. Thus, the ONC puncture failure probability is about five times higher than for an OFC.

For burstered munitions in an ONC, the time duration to detonate in an engulfing fire is 15 min (Table 3-1). Since the trucks are limited to only enough fuel for a 10 min fire, the detonation probability is quite low, estimated at 10^{-6} per accident.

A tornado-generated missile capable of puncturing the munition inside an ONC is estimated to require winds greater than 250 mph (compared to 310 mph for OFCs). The conditional probability of occurrence for these high winds, given a tornado with winds greater than 160 mph, is 1.7×10^{-4} for TEAD and 1.4×10^{-3} for ANAD. Given winds >250 mph, the conditional probability of agent containment failure is estimated at 3.0×10^{-5} (Appendix C).

8.1.5. Analytical Results

The results of the probabilistic analysis of the accident sequences (median frequency values) are shown in Table 8-16. Results for the onsite transportation from interim storage to the demil facility for the collocation options are shown separately in Table 8-17, including the

TABLE 8-16

ONSITE TRANSPORTATION - REGIONAL AND NATIONAL DISPOSAL OPTIONS
(MOVEMENT TO AND FROM RAIL, AIR, AND SEA IN OFFSITE PACKAGE)

Scenario Frequencies and Range Factors

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
VRBGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VRDHS	3	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	N/A	--
VRCGS	3	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	N/A	--
VRCHS	3	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	N/A	--
VRKGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	N/A	--
VRKHS	3	2.8E-10	2.2E+01	2.8E-10	2.2E+01	N/A	--	N/A	--	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VRKVS	3	2.8E-10	2.2E+01	N/A	--	N/A	--	2.8E-10	2.2E+01	N/A	--	N/A	--	2.8E-10	2.2E+01	N/A	--
VRMVS	3	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VRPGS	3	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VRPHS	3	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	N/A	--
VRPVS	3	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VRQGS	3	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VRQVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VRRGS	3	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VRRVS	3	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VRSVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VRDHC	4	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	N/A	--
VRCGC	4	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	N/A	--
VRCHC	4	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	N/A	--
VRMVC	4	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01
VRPGC	4	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01
VRPHC	4	3.0E-12	2.6E+01	N/A	--	3.0E-12	2.6E+01	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	N/A	--
VRPVC	4	3.0E-12	2.6E+01	N/A	--	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01
VRQGC	4	3.0E-12	2.6E+01	N/A	--	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01
VRQVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01
VRRGC	4	2.2E-10	2.6E+01	N/A	--	2.2E-10	2.6E+01	N/A	--	2.2E-10	2.6E+01	N/A	--	2.2E-10	2.6E+01	2.2E-10	2.6E+01
VRRVC	4	2.2E-10	2.6E+01	N/A	--	2.2E-10	2.6E+01	N/A	--	2.2E-10	2.6E+01	N/A	--	2.2E-10	2.6E+01	2.2E-10	2.6E+01
VRBGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01
VRDHC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	4.7E-09	2.0E+01	1.6E-10	2.0E+01	N/A	--

See notes at end of table.

File: ONSITREG.WK1 Page 2 Date 19-Aug-87

TABLE 8-16 (Continued)

ONSITE TRANSPORTATION - REGIONAL AND NATIONAL DISPOSAL OPTIONS
(MOVEMENT TO AND FROM RAIL IN OFFSITE PACKAGE)

Scenario Frequencies and Range Factors

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
VRCGC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VRCHC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	4.7E-09	2.0E+01	1.6E-10	2.0E+01	N/A	--
VRKGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VRKHS	6	6.0E-10	2.0E+01	7.2E-08	2.0E+01	N/A	--	N/A	--	1.1E-09	2.0E+01	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01
VRKVS	6	6.0E-10	2.0E+01	N/A	--	N/A	--	5.0E-10	2.0E+01	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VRMVC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	1.1E-09	2.0E+01	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01
VRPGC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01
VRPHC	6	6.0E-10	2.0E+01	N/A	--	2.7E-10	2.0E+01	N/A	--	N/A	--	4.7E-09	2.0E+01	1.6E-10	2.0E+01	N/A	--
VRPVC	6	6.0E-10	2.0E+01	N/A	--	2.7E-10	2.0E+01	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01
VRQGC	6	6.0E-10	2.0E+01	N/A	--	2.7E-10	2.0E+01	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01
VRQVC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01
VRRGC	6	6.0E-10	2.0E+01	N/A	--	2.7E-10	2.0E+01	N/A	--	1.1E-09	2.0E+01	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01
VRRVC	6	6.0E-10	2.0E+01	N/A	--	2.7E-10	2.0E+01	N/A	--	1.1E-09	2.0E+01	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01
VRSVS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01
VRBGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01
VRDHC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-09	2.0E+01	1.3E-10	2.0E+01	N/A	--
VRCGC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VRCHC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-09	2.0E+01	1.3E-10	2.0E+01	N/A	--
VRKGF	7	N/A	--	N/A	--	N/A	-	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VRKHF	7	4.9E-10	2.0E+01	5.9E-08	2.0E+01	N/A	--	N/A	--	9.1E-10	2.0E+01	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01
VRKVF	7	4.9E-10	2.0E+01	N/A	--	N/A	--	4.1E-10	2.0E+01	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VRMVC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	9.1E-10	2.0E+01	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01
VRPGC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01
VRPHC	7	4.9E-10	2.0E+01	N/A	--	2.3E-10	2.0E+01	N/A	--	N/A	--	3.9E-09	2.0E+01	1.3E-10	2.0E+01	N/A	--
VRPVC	7	4.9E-10	2.0E+01	N/A	--	2.3E-10	2.0E+01	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01
VRQGC	7	4.9E-10	2.0E+01	N/A	--	2.3E-10	2.0E+01	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01
VRQVC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01
VRRGC	7	4.9E-10	2.0E+01	N/A	--	2.3E-10	2.0E+01	N/A	--	9.1E-10	2.0E+01	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01
VRRVC	7	4.9E-10	2.0E+01	N/A	--	2.3E-10	2.0E+01	N/A	--	9.1E-10	2.0E+01	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01

See notes at end of table.

File: ONSITREG.WK1 Page 3 Date 19-Aug-87

TABLE 8-16 (Continued)

ONSITE TRANSPORTATION - REGIONAL AND NATIONAL DISPOSAL OPTIONS
(MOVEMENT TO AND FROM RAIL IN OFFSITE PACKAGE)

Scenario Frequencies and Range Factors

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
VRSVF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01
VRBGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01
VRDHS	11	1.2E-08	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.1E+01	2.0E-07	1.1E+01	N/A	--
VRCGS	11	1.2E-08	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-07	1.1E+01	N/A	--
VRCHS	11	1.2E-08	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.1E+01	2.0E-07	1.1E+01	N/A	--
VRKGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-07	1.1E+01	N/A	--
VRKHS	11	1.2E-08	1.1E+01	1.2E-08	1.1E+01	N/A	--	N/A	--	1.2E-08	1.1E+01	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01
VRKVS	11	1.2E-08	1.1E+01	N/A	--	N/A	--	4.1E-08	1.1E+01	N/A	--	N/A	--	2.0E-07	1.1E+01	N/A	--
VRNVS	11	1.2E-08	1.1E+01	N/A	--	N/A	--	N/A	--	1.2E-08	1.1E+01	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01
VRPGS	11	9.8E-08	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01
VRPHS	11	9.8E-08	1.1E+01	N/A	--	9.8E-08	1.1E+01	N/A	--	N/A	--	1.2E-08	1.1E+01	2.0E-07	1.1E+01	N/A	--
VRPVS	11	9.8E-08	1.1E+01	N/A	--	9.8E-08	1.1E+01	N/A	--	N/A	--	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01
VRQGS	11	9.8E-08	1.1E+01	N/A	--	9.8E-08	1.1E+01	N/A	--	N/A	--	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01
VRQVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01
VRRGS	11	1.2E-08	1.1E+01	N/A	--	1.2E-08	1.1E+01	N/A	--	1.2E-08	1.1E+01	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01
VRRVS	11	1.2E-08	1.1E+01	N/A	--	1.2E-08	1.1E+01	N/A	--	1.2E-08	1.1E+01	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01
VRSVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01
VRDHC	12	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--
VRCGC	12	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
VRCHC	12	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--
VRNVC	12	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--
VRPGC	12	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
VRPHC	12	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--
VRPVC	12	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
VRQGC	12	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
VRQVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
VRRGC	12	9.6E-09	2.0E+01	N/A	--	9.6E-09	2.0E+01	N/A	--	9.6E-09	2.0E+01	N/A	--	1.6E-07	1.6E+01	9.6E-09	2.0E+01
VRRVC	12	9.6E-09	2.0E+01	N/A	--	9.6E-09	2.0E+01	N/A	--	9.6E-09	2.0E+01	N/A	--	1.6E-07	1.6E+01	9.6E-09	2.0E+01
VRBGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--

See notes at end of table.

File: ONSITREG.WK1 Page 4 Date 19-Aug-87

TABLE 8-16 (Continued)

ONSITE TRANSPORTATION - REGIONAL AND NATIONAL DISPOSAL OPTIONS
(MOVEMENT TO AND FROM RAIL IN OFFSITE PACKAGE)

Scenario Frequencies and Range Factors

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
VRKGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
VRKHC	13	0.0E+00	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--
VRKVC	13	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--
VRSVC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--
VRBGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01
VRDHC	14	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	2.4E+01	6.8E-11	2.5E+01	N/A	--
VRCGC	14	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	N/A	--
VRCHC	14	2.1E-08	2.5E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	2.4E+01	6.8E-11	2.5E+01	N/A	--
VRKGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	N/A	--
VRKHC	14	2.1E-08	2.5E+01	1.1E-09	2.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01
VRKVC	14	2.1E-08	2.5E+01	N/A	--	N/A	--	2.1E-08	2.5E+01	N/A	--	N/A	--	6.8E-11	2.5E+01	N/A	--
VRMVC	14	2.1E-08	2.5E+01	N/A	--	N/A	--	N/A	--	2.1E-08	2.5E+01	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01
VRPGC	14	2.1E-08	2.5E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01
VRPHC	14	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	N/A	--	1.1E-09	2.4E+01	6.9E-11	2.5E+01	N/A	--
VRPVC	14	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01
VRQGC	14	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01
VRQVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01
VRRGC	14	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01
VRRVC	14	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01
VRSVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01
VRDHC	15	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-10	4.9E+01	2.2E-09	5.8E+01	N/A	--
VRCGC	15	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.8E+01	N/A	--
VRCHC	15	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-10	4.9E+01	2.2E-09	5.8E+01	N/A	--
VRMVC	15	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	3.7E-10	5.5E+01	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01
VRPGC	15	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01
VRPHC	15	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	N/A	--	2.6E-10	4.9E+01	2.2E-09	5.8E+01	N/A	--
VRPVC	15	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01
VRQGC	15	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01
VRQVC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01

See notes at end of table.

File: ONSITREG.WK1 Page 5 Date 19-Aug-87

TABLE 8-16 (Continued)

ONSITE TRANSPORTATION - REGIONAL AND NATIONAL DISPOSAL OPTIONS
(MOVEMENT TO AND FROM RAIL IN OFFSITE PACKAGE)

Scenario Frequencies and Range Factors

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
VRRGC	15	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01
VRRVC	15	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01

NOTES: 1. Scenarios 1-5 are per truck mile; scenarios 6-15 are per exposure year.
2. Duration time shown for scenarios with agent releases due to both detonations and spills is for spills only. Duration time for detonation is instantaneous.
3. National Disposal Option VRKVS ANAD is N/A.

TABLE 8-16 (Continued)

File: ONSITBRG.WK1 Page 1 Date 19-Aug-87

ONSITE TRANSPORTATION - AIR

Scenario Frequencies and Range Factors

SCENARIO	NO.	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR
VAKHS	1	0.0E+00	--	N/A	--	0.0E+00	--
VAPHS	1	N/A	--	0.0E+00	--	0.0E+00	--
VAPVS	1	N/A	--	0.0E+00	--	0.0E+00	--
VAQGS	1	N/A	--	0.0E+00	--	0.0E+00	--
VARGS	1	N/A	--	0.0E+00	--	0.0E+00	--
VARVS	1	N/A	--	0.0E+00	--	0.0E+00	--
VAKHS	2	0.0E+00	--	N/A	--	0.0E+00	--
VAPHS	2	N/A	--	0.0E+00	--	0.0E+00	--
VAPVS	2	N/A	--	0.0E+00	--	0.0E+00	--
VAQGS	2	N/A	--	0.0E+00	--	0.0E+00	--
VARGS	2	N/A	--	0.0E+00	--	0.0E+00	--
VARVS	2	N/A	--	0.0E+00	--	0.0E+00	--
VAKHS	3	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01
VAPHS	3	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VAPVS	3	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VAQGS	3	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VARGS	3	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VARVS	3	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01
VAPHC	4	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01
VAPVC	4	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01
VAQGC	4	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01
VARGC	4	N/A	--	2.2E-10	2.6E+01	2.2E-10	2.6E+01
VARVC	4	N/A	--	2.2E-10	2.6E+01	2.2E-10	2.6E+01
VAKHF	5	0.0E+00	--	N/A	--	0.0E+00	--
VAKHS	6	7.2E-08	2.0E+01	N/A	--	4.8E-09	2.0E+01
VAPHC	6	N/A	--	2.7E-10	2.0E+01	4.8E-09	2.0E+01
VAPVC	6	N/A	--	2.7E-10	2.0E+01	4.8E-09	2.0E+01
VAQGC	6	N/A	--	2.7E-10	2.0E+01	4.8E-09	2.0E+01
VARGC	6	N/A	--	2.7E-10	2.0E+01	4.8E-09	2.0E+01

TABLE 8-16 (Continued)

File: ONSITBRG.WK1 Page 2 Date 19-Aug-87

ONSITE TRANSPORTATION - AIR

Scenario Frequencies and Range Factors

SCENARIO	NO.	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR
VARVC	6	N/A	--	2.7E-10	2.0E+01	4.8E-09	2.0E+01
VAKHF	7	5.9E-08	2.0E+01	N/A	--	4.0E-09	2.0E+01
VAPHC	7	N/A	--	2.3E-10	2.0E+01	4.0E-09	2.0E+01
VAPVC	7	N/A	--	2.3E-10	2.0E+01	4.0E-09	2.0E+01
VAQGC	7	N/A	--	2.3E-10	2.0E+01	4.0E-09	2.0E+01
VARGC	7	N/A	--	2.3E-10	2.0E+01	4.0E-09	2.0E+01
VARVC	7	N/A	--	2.3E-10	2.0E+01	4.0E-09	2.0E+01
VAKHS	9	0.0E+00	--	N/A	--	0.0E+00	--
VAPHS	9	N/A	--	0.0E+00	--	0.0E+00	--
VAPVS	9	N/A	--	0.0E+00	--	0.0E+00	--
VAQGS	9	N/A	--	0.0E+00	--	0.0E+00	--
VARGS	9	N/A	--	0.0E+00	--	0.0E+00	--
VARVS	9	N/A	--	0.0E+00	--	0.0E+00	--
VAKHS	10	0.0E+00	--	N/A	--	0.0E+00	--
VAPHS	10	N/A	--	0.0E+00	--	0.0E+00	--
VAPVS	10	N/A	--	0.0E+00	--	0.0E+00	--
VAQGS	10	N/A	--	0.0E+00	--	0.0E+00	--
VARGS	10	N/A	--	0.0E+00	--	0.0E+00	--
VARVS	10	N/A	--	0.0E+00	--	0.0E+00	--
VAKHS	11	1.2E-08	2.2E+01	N/A	--	2.0E-07	2.2E+01
VAPHS	11	N/A	--	1.2E-08	2.2E+01	2.0E-07	2.2E+01
VAPVS	11	N/A	--	1.2E-08	2.2E+01	2.0E-07	2.2E+01
VAQGS	11	N/A	--	1.2E-08	2.2E+01	2.0E-07	2.2E+01
VARGS	11	N/A	--	1.2E-08	2.2E+01	2.0E-07	2.2E+01
VARVS	11	N/A	--	1.2E-08	2.2E+01	2.0E-07	2.2E+01
VAPHC	12	N/A	--	0.0E+00	--	0.0E+00	--
VAPVC	12	N/A	--	0.0E+00	--	0.0E+00	--
VAQGC	12	N/A	--	0.0E+00	--	0.0E+00	--
VARGC	12	N/A	--	9.6E-09	2.0E+01	1.6E-07	2.0E+01

TABLE 8-16 (Continued)

File: ONSITBRG.WK1 Page 1 Date 19-Aug-87

ONSITE TRANSPORTATION - AIR

Scenario Frequencies and Range Factors

SCENARIO	NO.	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR
VARVC	12	N/A	--	9.6E-09	2.0E+01	1.6E-07	2.0E+01
VAKHF	13	0.0E+00	--	N/A	--	0.0E+00	--
VAKHC	14	1.1E-09	2.4E+01	N/A	--	6.8E-11	2.5E+01
VAPHC	14	N/A	--	2.1E-08	2.5E+01	6.8E-11	2.5E+01
VAPVC	14	N/A	--	2.1E-08	2.5E+01	6.8E-11	2.5E+01
VAQGC	14	N/A	--	2.1E-08	2.5E+01	6.8E-11	2.5E+01
VARGC	14	N/A	--	2.1E-08	2.5E+01	6.8E-11	2.5E+01
VARVC	14	N/A	--	2.1E-08	2.5E+01	6.8E-11	2.5E+01
VAPHC	15	N/A	--	3.7E-10	5.5E+01	2.2E-09	5.8E+01
VAPVC	15	N/A	--	3.7E-10	5.5E+01	2.2E-09	5.8E+01
VAQGC	15	N/A	--	3.7E-10	5.5E+01	2.2E-09	5.8E+01
VARGC	15	N/A	--	3.7E-10	5.5E+01	2.2E-09	5.8E+01
VARVC	15	N/A	--	3.7E-10	5.5E+01	2.2E-09	5.8E+01

TABLE 8-16 (Continued)

Page 1 Date 21-Aug-87

ONSITE TRANSPORTATION - BARGE

Scenario Frequencies and Range Factors

SCENARIO	NO.	APG FREQ	RANGE FACTOR
VWKHS	1	0.0E+00	--
VWKHS	2	0.0E+00	--
VWKHS	3	2.7E-11	26
VWKHF	5	0.0E+00	--
VWKHS	6	2.3E-07	20
VWKHF	7	1.9E-07	20
VWKHS	9	0.0E+00	--
VWKHS	10	0.0E+00	--
VWKHS	11	1.2E-09	14
VWKHF	13	0.0E+00	--
VWKHF	14	1.1E-09	24

TABLE 8-17

ONSITE TRANSPORTATION - ONSITE PACKAGE - COLLOCATION OPTION

(MOVEMENT FROM STORAGE TO DEMIL FACILITY IN ONSITE PACKAGE)

Scenario Frequencies and Range Factors

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
VOBGS	1	N/A		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VODHS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOCGS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOCHS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOKGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOKHS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOKVS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOMVS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOPGS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOPHS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOFVS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOQGS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOQVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VORGS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VORVS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOSVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOWGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--
VOBGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VODHS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOCGS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOCHS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOKGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOKHS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOKVS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOMVS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOPGS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOPHS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOFVS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOQGS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--

See notes at end of table.

TABLE 8-17 (Continued)

Scenario Frequencies and Range Factors

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
VOQVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOKGS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VORVS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOSVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VOWGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--
VODHC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--
VOCGC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--
VOCHC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--
VOMVC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--
VOPGC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--
VOPHC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--
VOPVC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--
VOQGC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--
VOQVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--
VORGC	4	2.8E-10	3.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	3.3E+01	N/A	--
VORVC	4	2.8E-10	3.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	3.3E+01	N/A	--
VOBGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-14	1.6E+02	N/A	--
VOKGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-14	1.6E+02	N/A	--
VOKHF	5	2.8E-14	1.6E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-14	1.6E+02	N/A	--
VOKVF	5	2.8E-14	1.6E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-14	1.6E+02	N/A	--
VOSVF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-14	1.6E+02	N/A	--
VOWGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-14	1.6E+02	N/A	--
VOBGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VODHC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOCGC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOCHC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOKGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOKHS	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOKVS	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--

See notes at end of table.

TABLE 8-17 (Continued)

Scenario Frequencies and Range Factors

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
VOMVC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOPGC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOPHC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOPVC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOQGC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOQVC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VORGC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VORVC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOSVS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOWGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--
VOBGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VODHC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOCGC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOCHC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOKGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOKHF	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOKVF	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOMVC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOPGC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOPHC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOPVC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOQGC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOQVC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VORGC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VORVC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOSVF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOWGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--
VOBGS	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VODHS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--

See notes at end of table.

TABLE 8-17 (Continued)

Scenario Frequencies and Range Factors

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
VOCGS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	--	N/A	--
VOCHS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VOKGS	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VOKHS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VOKVS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VOMVS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VOPGS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VOPHS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VOPVS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VOQGS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VOQVS	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VORGS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VORVS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VOSVS	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VOWGS	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--
VOBGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VODHS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOCGS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOCHS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOKGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOKHS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOKVS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOMVS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOPGS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOPHS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOPVS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOQGS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOQVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VORGS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--

See notes at end of table.

File: ONSITREG.WK1 Page 5 Date 19-Aug-87

TABLE 8-17 (Continued)

Scenario Frequencies and Range Factors

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
VORVS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOSVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VOWGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--
VODHC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--
VOCGC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--
VOCHC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--
VOMVC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--
VOPGC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--
VOPHC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--
VOPVC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--
VOQGC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--
VOQVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--
VORGC	12	1.2E-08	1.7E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-07	2.0E+01	N/A	--
VORVC	12	1.2E-08	1.7E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-07	2.0E+01	N/A	--
VOBGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	1.0E+02	N/A	--
VOKGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	1.0E+02	N/A	--
VOKHC	13	4.2E-13	1.1E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	1.0E+02	N/A	--
VOKVC	13	4.2E-13	1.1E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	1.0E+02	N/A	--
VOSVC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	1.0E+02	N/A	--
VOWGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	1.0E+02	N/A	--
VOBGC	14	N/A		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VODHC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VOCGC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VOCHC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VOKGS	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VOKHS	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VOKVS	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VOMVC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VOPGC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--

See notes at end of table.

File: ONSITREG.WK1 Page 6 Date 19-Aug-87

TABLE 8-17 (Continued)

Scenario Frequencies and Range Factors

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR
VOPHC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VOPVC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VOQGC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VOQVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VORGC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VORVC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VOSVS	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VOWGC	14	N/A		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--
VODHC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--
VOCGC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--
VOCHC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--
VOMVC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--
VOPGC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--
VOPHC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--
VOPVC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--
VOQGC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--
VOQVC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--
VORGC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--
VORVC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--

NOTES: 1. Scenarios 1-5 are per truck mile; scenarios 6-15 are per exposure year.
2. Duration time shown for scenarios with agent releases due to both detonations and spills is for spills only. Duration time for detonation is instantaneous.

results of the uncertainty analysis of the sequence frequency values. The range factor is the ratio of the 95th percentile value to the 50th percentile value of a log normal distribution. The accident frequencies for sequences 1 to 5 are reported per truck mile. The accident frequencies for sequences 6 to 15 are reported per exposure year. No quantitative screening of the sequences was done at this point in the analysis because the accidents per mile need to be multiplied by the number of miles (a classified number) prior to a meaningful screening analysis.

The number of munitions truckloads is computed from the classified stockpile values divided by the number of munitions per truck load from Table 10-3. The accident frequency is determined by first multiplying the values in Table 8-16 by the number of truckloads. This product is multiplied either by the number of onsite truck miles or by the number of onsite truck exposure years. It is assumed that the trucks move individually to and from the railhead at an effective speed of 10 mph. The total exposure time is the onsite distance divided by 10 mph.

The calculation models described in Section 10 were used to determine the agent released for the onsite transportation accident sequences. The agent release results for these accident sequences are also given in Section 10.

The final results of the accident sequence analysis (per munition inventory) are contained in a classified appendix to this report.

8.2. OFFSITE RAIL TRANSPORT

8.2.1. Accident Scenario Definition

The transport accident scenarios involve train accidents (derailment, collision, highway grade crossings) with and without fires, and nonpreventable external events. The four types of force which could fail the munition casing or its package and cause an agent release (crush, impact, puncture, and fire) were also considered when the accident scenarios were developed.

Section 4-1 describes the selection of the initiating events. As shown in Table 4-6, there are four families of initiating events for rail transport: (1) train accident (e.g., derailment) due to human error or equipment failure, (2) an aircraft crash into a railcar, (3) an earthquake-caused train accident, and (4) a tornado-caused train accident or generated missile penetration. Fourteen sequences were analyzed, resulting from the logic model development (Section 8.2.3) of these four initiating event families. These are as follows:

1. Train Accident Due to Human Error or Equipment Failure.

   RC1 - A train accident involving a munitions railcar occurs and crush forces fail the agent containment.

   RC2 - A train accident involving a munitions railcar occurs and impact forces fail the agent containment.

   RC3 - A train accident involving a munitions railcar occurs and puncture forces fail the agent containment.

   RC4 - A train accident with fire occurs. Either the OFC insulation is torn away due to mechanical forces and the fire is able to heat the munitions inside the OFC,

or the fire lasts long enough to cause burstered munitions to detonate. Undue force created by the accident may also detonate burstered munitions.

RC5 - A train accident with fire occurs. Either the OFC insulation is torn away due to mechanical forces and the fire is able to heat the munitions inside the OFC, or the fire lasts long enough to cause thermal rupture of the munitions.

RC15 - A train accident occurs due to an earthquake or tornado, generating undue mechanical forces which cause detonation of burstered munitions.

2. Aircraft Crash Into Railcars.

RC6 - An aircraft crashes on a munitions railcar. No fire occurs, but impact forces lead to detonations and/or failure of agent containment.

RC7 - An aircraft crashes on a munitions railcar. Fire occurs, but impact forces lead to detonation and/or failure of agent containment.

RC8 - Open due to scenario revisions.

3. Earthquake-caused Train Accident.

RC9 - A severe earthquake occurs involving a munitions railcar and crush forces fail the agent containment.

RC10 - A severe earthquake occurs involving a munitions railcar and impact forces fail the agent containment.

RC11 - A severe earthquake occurs involving a munitions railcar and puncture forces fail the agent containment.

RC12 - A severe earthquake occurs involving a munitions railcar and subsequent fire detonates burstered munitions.

RC13 - A severe earthquake occurs involving a munitions railcar and subsequent fire fails nonburstered munitions.

4. Tornado Event.

RC14 - A tornado-generated missile leads to failure of the agent containment, or a tornado occurs causing overturn or derailment of a munitions railcar.

An inherent assumption in this list of sequences is that the accidents involving an aircraft crashing on a munitions railcar more closely resemble the SNL model of a typical aircraft crash rather than the SNL model of a typical train crash. Unlike the train accident scenarios where the impact failure probability is ϵ, in a typical SNL aircraft crash the crush and puncture forces are negligible compared to the impact forces. It is also assumed that all aircraft crashes onto a railcar are totally uncontrolled crashes and therefore always have impact forces and that the crash is a severe one ($\Delta V > 300$ mph). Reference 8-1 contains further details.

8.2.2. Rail Transport Procedures and Data

Prior to rail transportation, all chemical munitions will be secured in 20 x 8 x 8 ft offsite transportation containers. It is assumed that the munitions within the transportation container will not experience any impact as a result of a train accident. The transportation container provides additional protection from crush, impact, puncture, or fire.

Two transportation containers are securely mounted one-high on each railcar. Inventories of agent for each munition and agent type are shown in Table 10-3.

For the regional option, munitions from NAAP, APG, LBAD, and PBA will be transported to ANAD and from all other sites to TEAD. In the national option, all munitions are sent to a single destruction center at TEAD. Mileages for these routes are given in Table 8-18.

Data on rates of rail accidents are presented in Section 9.1.1 and are summarized in Table 8-19. A rate of 5.5×10^{-6} accidents per rail mile was derived. The train fire accident rate was derived from data from Refs. 8-1 and 8-13. Train fires, without any special mitigation, involve only a single car in 90% of all cases (Ref. 8-13).

The fires of interest, then, are (1) derailment fires involving locomotive fuel, (2) collision fires involving locomotive fuel, and (3) grade-crossing collisions with a tanker on the track.

In accidents involving derailment of munitions trains, the most likely source of fire is the locomotive fuel; therefore, the locomotive itself must be severely damaged. For general cargo trains, about 1% of the derailments results in fire (Ref. 8-1) and it is assumed that the probability that the locomotive is one of the derailed cars is 0.5 (Ref. 8-13). Furthermore, since five buffer cars containing inert material are always placed between the locomotives and the first munitions car, the probability that a munitions car is exposed to the fire is assumed to be 0.01. (Reference 8-13 assumes that with only one buffer car there is a 0.1 probability of munitions car exposure to the fire.) Thus, the probability of a munitions car fire given a derailment equals (5.5×10^{-6} accidents/train mile) x (0.83 derailments/accident) x (0.5 locomotive derailments/derailment) x (0.01 locomotive fires/locomotive derailments) x (0.01 munition car exposures/locomotive fires) = 2.3×10^{-10} fires/train mile.

TABLE 8-18
TRAVEL MILES FOR RAIL TRANSPORT[a]

Storage Depot	Rail	
	To Tooele	To Anniston
Aberdeen Proving Ground	3035	1805
Anniston	2834	--
Lexington-Blue Grass	2546	1106
Newport	2201	980
Pine Bluff	2624	1243
Pueblo	732	--
Umatilla	1250	--

[a]Reference 8-11.

TABLE 8-19
RAIL TRANSPORTATION DATA

Train accident rate	5.5×10^{-6} accidents/mile
Fire accident probability, given an accident	3.9×10^{-4}
Impact environment probability	1.0
Crush environment probability	0.002
Puncture environment probability	5.9×10^{-4}
Aircraft crash onto a railcar probability	3.1×10^{-11}
Undue mechanical force probability	5.8×10^{-7}

Route	0.35-g Earthquake Probabilities	Tornado Probabilities (yr^{-1})
Umatilla to Tooele	8.2×10^{-4}	3.3×10^{-7}
Pueblo to Tooele	2.5×10^{-4}	3.7×10^{-7}
Lexington to Tooele	5.1×10^{-4}	7.3×10^{-5}
Aberdeen to Tooele	1.9×10^{-4}	6.8×10^{-5}
Anniston to Tooele	2.4×10^{-4}	7.6×10^{-5}
Newport to Tooele	2.2×10^{-4}	6.6×10^{-5}
Pine Bluff to Tooele	2.7×10^{-4}	7.3×10^{-5}
Lexington to Anniston	2.8×10^{-4}	1.0×10^{-4}
Pine Bluff to Anniston	5.3×10^{-4}	1.0×10^{-4}
Aberdeen to Anniston	2.0×10^{-4}	9.3×10^{-5}
Newport to Anniston	3.0×10^{-4}	1.0×10^{-4}

For munitions train collision accidents, the most likely source of fire is again the locomotives; however, the probability that a munitions car will be affected by the fire is assumed to be 0.05 since the five buffer cars are expected to be less effective in a collision than in a fire. (Reference 8-13 assumes a value of 0.3 for only one buffer car.) Thus, using data presented earlier in this section: (5.5×10^{-6} accidents/train mile) (0.066 collisions/accident) (0.01 fires/collision) (0.26 locomotive fires/collision) (0.05 munitions car exposures/ locomotive fires) = 4.7×10^{-11} fires/train mile.

The third fire component, fires given a grade crossing collision is: (5.5×10^{-6} accidents/train mile) (0.038 grade crossing accidents/ accident) (0.02 tanker accidents/grade crossing accident) (0.5) (0.9) = 1.9×10^{-9} fires/train mile. Here, 0.5 is the probability that the tanker is full of fuel and 0.9 is the probability that when the train comes to a stop, a munitions car is in the fire.

The total munition car fires/train mile is the sum of the three contributors, $2.3 \times 10^{-10} + 4.7 \times 10^{-11} + 1.9 \times 10^{-9} = 2.2 \times 10^{-9}$. For use in the scenario calculations, the train accident rate was divided out ($2.2 \times 10^{-9}/5.5 \times 10^{-6}$) for 3.9×10^{-4} fires, given a train accident. The train fire duration curves are shown in Fig. 8-7 for locomotive fires and train-tanker accident fires. These curves are used to obtain the probabilities of a fire having the duration to fail the agent containment. The shape of the train tanker fire duration curve is due to a number of factors including: (1) variation in tanker truck size, (2) distribution of spilled fuel, and (3) type and effectiveness of fire fighting response.

The worst-case impact environment for small packages (munitions inside OFCs) is no more severe than normal rough handling; therefore, impact is not a threat to small cargo in a railcar (Ref. 8-1). The severity distribution for large package impacts is shown in Fig. 8-8.

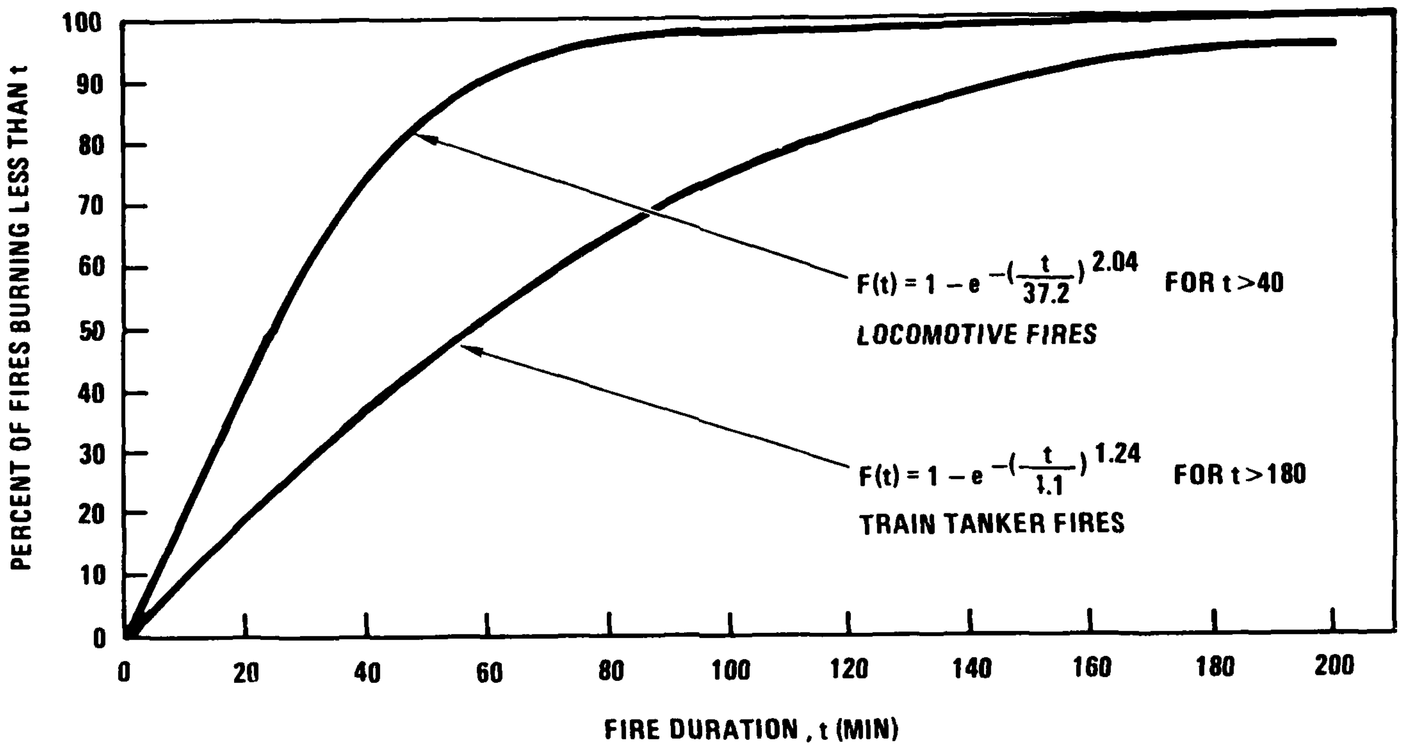


Fig. 8-7. Cumulative distribution of fire durations for train-tanker accidents and locomotive fires

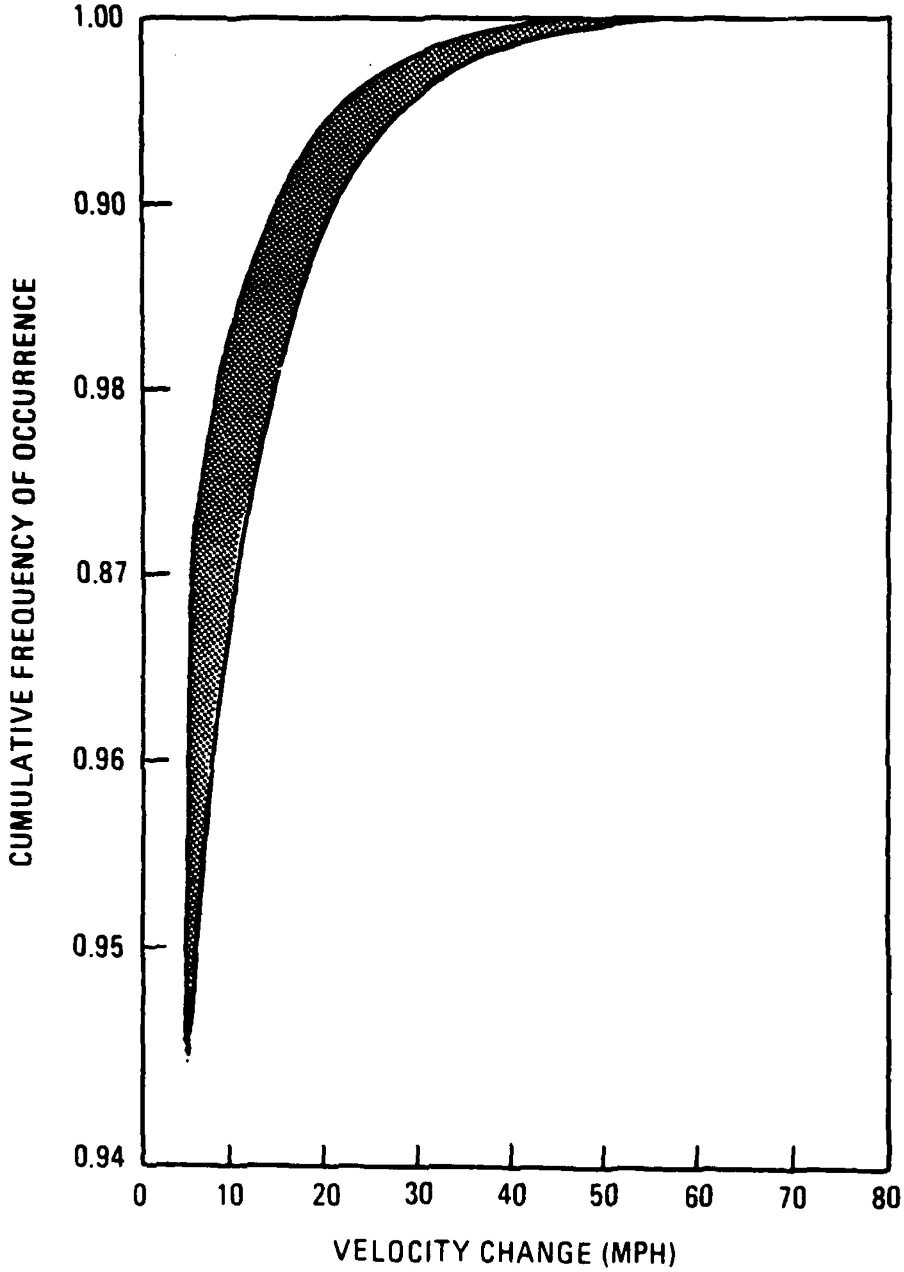


Fig. 8-8. Impact velocity distribution for large packages in train accidents

The probability of a crush environment for large packages is 0.002, and the severity distribution is given in Fig. 8-9 (Ref. 8-2).

The probability of a puncture environment for large packages with a 0.75-in. steel wall thickness is 5.9×10^{-4} given a cargo damage accident. The probe considered capable of puncture was a railcar coupler (Ref. 8-2).

The probability of undue mechanical crush force causing detonation of burstered munitions was derived from the dynamic crush probability data in Ref. 8-1, assuming a lognormal distribution with a 50% probability of detonation at 3×10^6 lb of crush force and a 10^{-6} probability for 36,000 lb of force.

8.2.3. Event Tree Analysis

The event tree used in the analysis of a train accident due to earthquake or human error or equipment failure is shown in Fig. 8-10. Top events identified in the event tree and the analysis elements needed to evaluate the probabilities of these top events are as follows:

BE33 - Initiating event (train accident occurs, e.g., derailment, collision, grade crossing collision, aircraft crash, earthquake, etc.). The appropriate value for BE33 is given in the discussion for each sequence.

BE51 - Probe fails munition inside OFC.

BE52 - Impact force sufficient to fail munition inside OFC.

BE52′ - Mechanical forces remove insulation from OFC.

BE53 - Crush force sufficient to fail munition inside OFC.

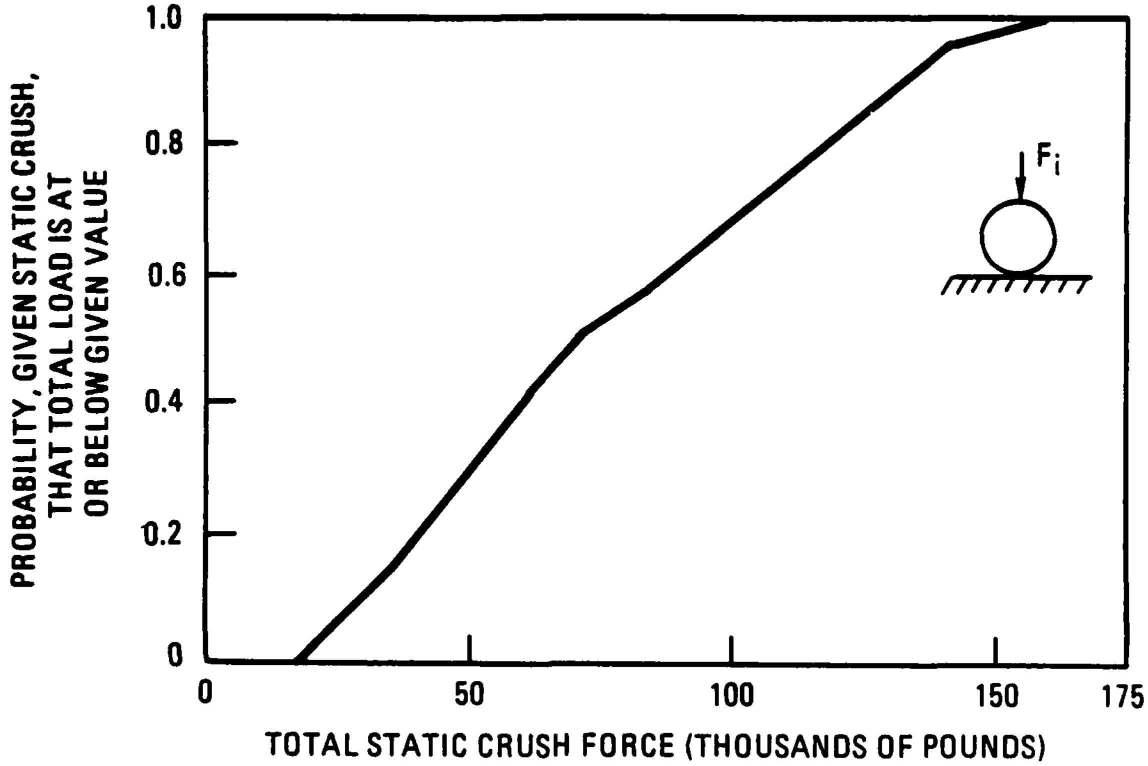
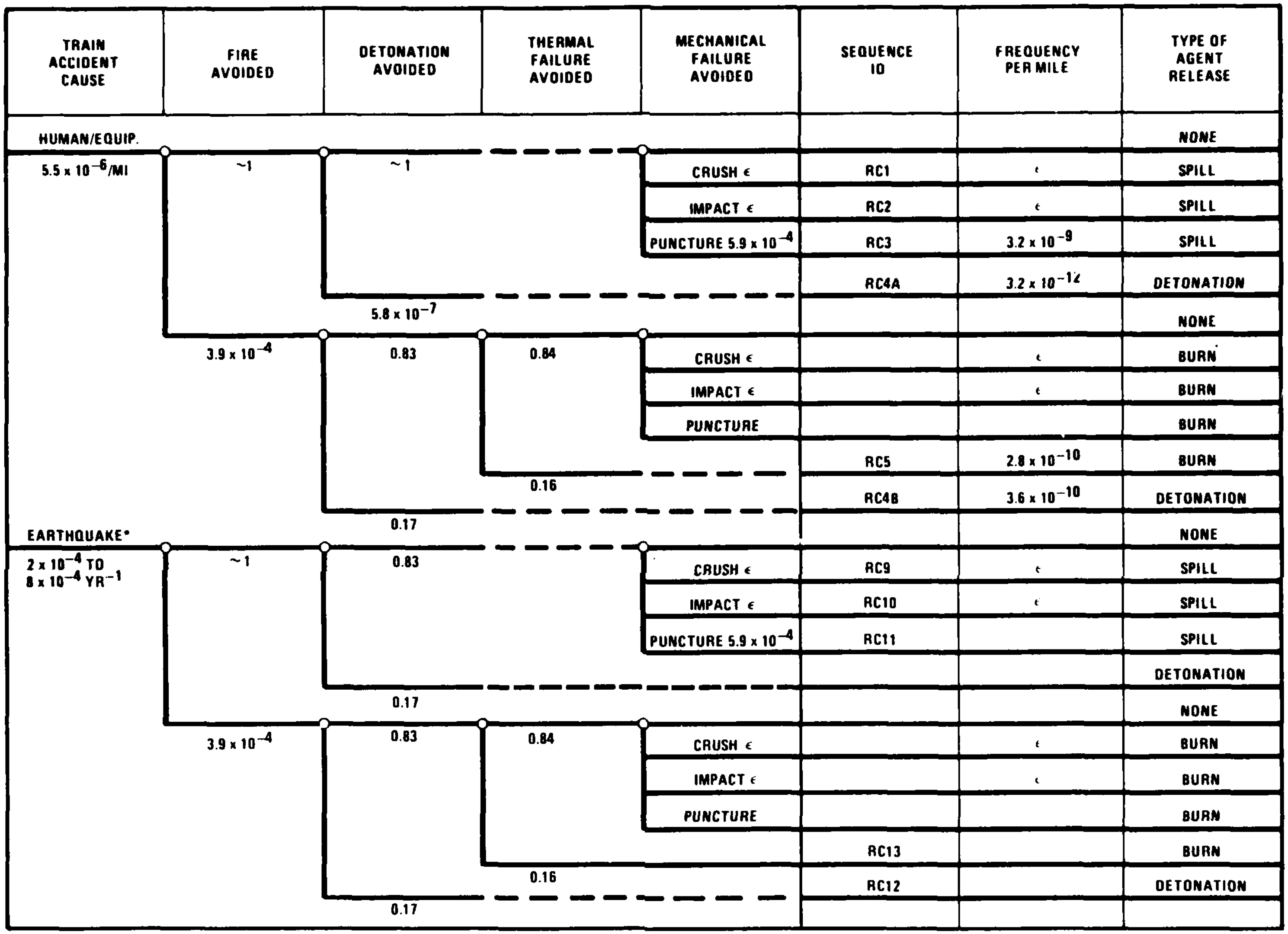


Fig. 8-9. Cumulative distribution of total crush load for a large package in train accident



*FREQUENCIES ARE ROUTE DEPENDENT, RANGE COVERS ALL SITE COMBINATIONS

NOTE: ϵ INDICATES SEQUENCES SCREENED ON LOW FREQUENCY

Fig. 8-10. Event tree for train accident caused by earthquake or human error/equipment failure

BE60 - Impact force generated.

BE61 - Impact force sufficient fails munition.

BE62 - Fire generated.

BE60/62 - Impact and fire generated.

BE63 - Fire has heat and duration to detonate burster in OFC.

BE64 - Probe generated.

BE68 - Crush force generated.

BE75 - Fire has heat and duration to fail nonburstered munitions in OFC.

The probability data for the accident sequences are summarized in Tables 8-20 through 8-33.

The results of the rail transport probabilistic analysis as well as the agent release calculations are summarized in Appendix I for the national and regional disposal options. The probabilities are given on a per train mile basis for sequences RC1 through RC5 and per train exposure year for sequences RC6 through RC14. The final probability values per munition inventory are contained in a classified appendix to this report.

Tables 8-34 and 8-35 present the results of the rail transport frequency and uncertainty assessment for the national and regional collocation options, respectively.

TABLE 8-20
RAIL TRANSPORT SEQUENCE 1

RC1 - A train accident occurs and crush forces fail OFC and munition: the sequence frequency is the product of the events: BE33, BE68, and BE53.

Event No.	Name	Probability	Reference/Remarks
BE33	Train accident occurs	5.5×10^{-6} per mile	Derived by H&R from Refs. 8-1 and 8-14.
BE68	Crush force generated	0.002	Reference 8-1, for small packages.
BE53	Crush force fails OFC and munition	ϵ	From SNL rail crush curve Fig. 8-8; at 160,000 lb, probability approaches zero. OFC is designed to withstand 520,000 lb of evenly distributed static load.

TABLE 8-21
RAIL TRANSPORT SEQUENCE 2

RC2 - A train accident occurs and impact forces fail OFC and munition: the sequence frequency is the product of the events: BE33, BE60, BE52, and BE61.

Event No.	Name	Probability	Reference/Remarks
BE33	Train accident occurs	5.5×10^{-6} per mile	Derived by H&R from Refs. 8-1 and 8-14.
BE60	Impact force generated	1	Reference 8-2.
BE52	Impact force fails OFC	0.003	Figure 8-8.
BE61	Impact force fails munition	ϵ	All munitions fail at thresholds greater than 35 mph. Impact energy is absorbed during package failure and insufficient force is left to fail the munition. Per Ref. 8-1, small packages experience no impact greater than during normal handling.

TABLE 8-22
RAIL TRANSPORT SEQUENCE 3

RC3 - A train accident occurs and puncture forces fail the container and munition: the sequence frequency is the product of the events: BE33, BE64, and BE51.

Event No.	Name	Probability	Reference/Remarks
BE33	Train accident occurs	5.5×10^{-6} per mile	Derived by H&R from Refs. 8-1 and 8-14.
BE64	Probe generated capable of puncturing 0.75-in. steel	5.9×10^{-4}	The probe is defined as a railcar coupler.
BE51	Probe fails OFC and munition (>200 s^{-1})	1	This is conservative for heavy walled munitions.

Note: The probability of puncture and fine is insignificant in comparison with puncture alone or fire-only events.

TABLE 8-23
RAIL TRANSPORT SEQUENCE 4

RC4 - A train accident occurs with subsequent fire and accident forces cause detonation of burstered munitions (types C, P, M, R). Detonation may be due to fire only, impact plus fire, or undue force. The sequence frequency is given by the equation (BE33) (BE62) (BE63) + (BE33) (BE52′) (BE62) (BE63A) + (BE33) (BE53).

Event No.	Name	Probability	Reference/Remarks
BE33	Train accident occurs	5.5×10^{-6} per mile	Derived by H&R from Refs. 8-1 and 8-14.
BE62	Fire generated	3.9×10^{-4}	Derived by H&R from Refs. 8-1 and 8-13.
BE63	Fire has heat (1850°F) and duration to detonate burstered munition in OFC (>2 h)	0.16	Figure 8-7.
BE52′	Mechanical forces destroy OFC insulation	0.01	Ref. 8-6.
BE63A	Fire has heat (1475°F) and duration to detonate burstered munition in degraded package (>30 min)		SNL train fire duration curve, Fig. 8-7.
	C 49 min	0.55	
	P 89 min	0.3	
	M 68 min	0.4	
	R 10.5 min	0.75	
BE53	Undue force detonates burstered munitions	8.3×10^{-6}	Reference 8-6.

TABLE 8-24
RAIL TRANSPORT SEQUENCE 5

RC5 - A train accident occurs with subsequent fire and accident forces fail nonburstered munitions, types B, S, K. The sequence frequency is the product of events: BE33, BE62, and BE75, added to the product of events: BE33, BE62, BE52′, and BE75A.

Event No.	Name	Probability	Reference/Remarks
BE33	Train accident occurs	5.5×10^{-6} per mile	Derived by H&R from Refs. 8-1 and 8-14.
BE62	Fire generated	3.9×10^{-4}	Derived by H&R from Refs. 8-1 and 8-13.
BE75	Fire has heat (1850°F) and duration to fail non-burstered munition in OFC (>2 h)	0.16	Figure 8-7.
BE52′	Mechanical forces destroy OFC insulation	0.01	Ref. 8-6.
BE75A	Fire has heat (1475°F) and duration to fail nonburstered munitions in degraded package (>30 min)	0.16	SNL train fire duration curve, Fig. 8-7.

TABLE 8-25
RAIL TRANSPORT SEQUENCE 6

RC6 - Aircraft crashes onto railcar, no fire; impact force fails OFC and munition: the sequence frequency is the product of events: BE33, BE60, BE52, and BE61.

Event No.	Name	Probability	Reference/Remarks
BE33	Aircraft crash	3.1×10^{-11} per year	See Section 4.2.
BE60	Impact-only force generated	0.55	Ref. 8-1; 0.27 impact only/0.49 all impacts = 0.55.
BE52	Impact force fails OFC (>35 mph)	1	Assumes a severe crash (>300 mph)
BE61	Impact force fails munition	1	Conservative for heavy-walled munitions.

TABLE 8-26
RAIL TRANSPORT SEQUENCE 7

RC7 - Aircraft crashes onto railcar, fire occurs, impact-induced failure of OFC and munitions: the sequence frequency is the product of the events: BE33, BE60/62, BE52, and BE61.

Event No.	Name	Probability	Reference/Remarks
BE33	Aircraft crash	3.1×10^{-11} per year	See Section 4.2.
BE60/62	Impact and fire generated	0.45	Ref. 8-1; 0.22/0.49 fire and impact/all impact = 0.45.
BE52	Impact force fails OFC (>35 mph)	1	Assumes a severe crash (>300 mph).
BE61	Impact force fails munition	1	Conservative for heavy-walled munitions.

TABLE 8-27
RAIL TRANSPORT SEQUENCE 9

RC9 - An earthquake occurs and crush forces fail the OFC and the munition: the sequence frequency is the products of events: BE33, BE68, and BE53.

Event No.	Name	Probability	Reference/Remarks
BE33	Earthquake occurs (per year)		Route- and site-specific; derived by H&R from basic earthquake probability value (GA) and summing length of time train is in each seismic zone.
	UDA to TEAD	8.2×10^{-4}	
	PUDA to TEAD	2.5×10^{-4}	
	LBAD to TEAD	5.1×10^{-4}	
	APG to TEAD	1.9×10^{-4}	
	ANAD to TEAD	2.4×10^{-4}	
	NAAP to TEAD	2.2×10^{-4}	
	PBA to TEAD	2.8×10^{-4}	
	PBA to ANAD	5.3×10^{-4}	
	APG to ANAD	2.0×10^{-4}	
	NAAP to ANAD	3.0×10^{-4}	
BE68	Crush force generated	0.002	SNL, for small packages.
BE53	Crush force fails OFC	ϵ	See sequence 1.

TABLE 8-28
RAIL TRANSPORT SEQUENCE 10

RC10 - An earthquake occurs and impact forces fail the OFC and munition: the sequence frequency is the product of the events: BE33, BE60, BE52, and BE61.

Event No.	Name	Probability	Reference/Remarks
BE33	Earthquake occurs	See sequence 9	Route- and site-specific derived by H&R from basic earthquake probability.
BE60	Impact force generated	1	Reference 8-2.
BE52	Impact force sufficient to fail munition and OFC	0.003	Figure 8-8.
BE61	Impact force fails agent containment.	ϵ	See sequence 2.

TABLE 8-29
RAIL TRANSPORT SEQUENCE 11

RC11 - An earthquake occurs and puncture forces fail the munition and OFC: the sequence frequency is the product of events: BE33, BE64, and BE51.

Event No.	Name	Probability	Reference/Remarks
BE33	Earthquake occurs	See sequence 9	Route- and site-specific; derived by H&R from basic earthquake probability in Section 4.2.
BE64	Probe generated capable of puncturing 0.75-in. steel	5.9×10^{-4}	Reference 8-2.
BE51	Probe fails OFC ($>200\ s^{-1}$)	1	Conservative for heavy-walled munitions.

TABLE 8-30
RAIL TRANSPORT SEQUENCE 12

RC12 - An earthquake occurs causing a train accident with fire, resulting in detonation of burstered munitions (types C, P, M, R). The sequence frequency is given by the equation (BE33) (BE62) (BE63) + (BE33) (BE62) (BE52′) (BE63A)

Event No.	Name	Probability	Reference/Remarks
BE33	Earthquake occurs	See sequence 9	Route- and site-specific; derived by H&R from basic earthquake probability.
BE62	Fire generated (given a train accident)	3.9 x 10-4	Derived by H&R from Refs. 8-1 and 8-13.
BE63	Fire has heat (1850°F) and duration to detonate burstered munition in OFC (>2 h)	0.16	Figure 8-7.
BE52′	Mechanical forces destroy OFC insulation	0.01	Ref. 8-6.
BE63A	Fire has heat (1475°F) and duration to fail burstered munition in degraded OFC (>30 min)	See sequence 4	SNL train fire duration curve; Fig. 8-7.

TABLE 8-31
RAIL TRANSPORT SEQUENCE 13

RC13 - An earthquake occurs causing a train accident with fire, resulting in failure of nonburstered munitions (types B, S, K): the sequence frequency is given by the equation: (BE33) (BE62) (BE75) + (BE33) (BE62) (BE52′) (BE75A)

Event No.	Name	Probability	Reference/Remarks
BE33	Earthquake occurs	See sequence 9	Route- and site-specific derived by H&R from basic earthquake probability; site- and route-specific.
BE62	Fire generated	3.9×10^{-4}	Derived by H&R from Refs. 8-1 and 8-13.
BE75	Fire has heat (1850°F) and duration to fail nonburstered munition in OFC (>2 h)	0.16	Figure 8-7.
BE52′	Mechanical forces destroy OFC insulation	0.01	Ref. 8-6.
BE75A	Fire has heat (1475°F) and duration to fail nonburstered munition in degraded OFC	See sequence 4	SNL train fire duration curve, Fig. 8-7.

TABLE 8-32
RAIL TRANSPORT SEQUENCE 14

RC14 - (A) A tornado-generated missile penetrates munition: the sequence frequency is the product of events: BE33, BE64, and BE51, or

(B) Tornado-generated derailment with mechanical forces occurs causing OFC/munition failure: the sequence frequency is given by the equation (BE33) (BE68, 60, or 64A) (BE53, 52, or 51A)

Event No.	Name	Probability	Reference/Remarks
BE33	Tornado occurs (winds >160 mph)	Table 8-19	Route- and site-specific; derived by H&R.
BE64	Probe generated capable of failing agent containment	UMDA 1.7×10^{-4} PUDA 3.0×10^{-3} Others 1.4×10^{-3}	Fraction of winds >160 mph that are also >310 mph.
BE51	Missile has orientation to fail agent containment	5.3×10^{-5}	Appendix C.
BE68	Crush force generated	0.002	Reference 8-2.
BE60	Impact force generated	1	Reference 8-2.
BE64A	Probe generated	5.9×10^{-4}	Probe is defined as a railcar coupler.
BE53	Crush fails OFC	ϵ	Same as sequence 1.
BE52	Impact fails OFC and munition	ϵ	Same as sequence 2.
BE51A	Probe fails agent containment	1	Same as sequence 3, conservative for heavy-walled munitions.

TABLE 8-33
RAIL TRANSPORT SEQUENCE 15

RC15 - A train accident occurs as a result of an earthquake or tornado, generating undue mechanical forces which cause detonation of burstered munitions: the sequence frequency is the product of events BE33 and BE53 added to the product of event BE33A and BE53.

Event No.	Name	Probability	Reference/Remarks
BE33	Earthquake occurs	Table 8-19	Derived by H&R Ref. 8-4.
BE33A	Tornado occurs	Table 8-19	Based on Section 4.2.
BE53	Crush force sufficient to detonate burster in OFC	8.3×10^{-6}	Ref. 8-6.

TABLE 8-34
OFFSITE RAIL TRANSPORTATION - NATIONAL DISPOSAL OPTION

Accident Frequencies and Range Factors

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR
RCBGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10
RCDHS	3	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--
RCCGS	3	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHS	3	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--
RCKGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHS	3	3.2E-09	10	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10
RCKVS	3	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--
RCMVS	3	3.2E-09	10	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10
RCPGS	3	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10
RCPHS	3	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--
RCPVS	3	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10
RCQGS	3	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10
RCQVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10
RCRGS	3	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10
RCRVS	3	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10
RCSVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10
RCDHC	4	4.4E-10	23	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	23	N/A	--	N/A	--
RCCGC	4	4.4E-10	23	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHC	4	4.4E-10	23	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	23	N/A	--	N/A	--
RCMVC	4	4.4E-10	21	N/A	--	N/A	--	N/A	--	4.4E-10	21	N/A	--	N/A	--	4.4E-10	21
RCPGC	4	4.4E-10	27	N/A	--	N/A		N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27
RCPHC	4	4.4E-10	27	N/A	--	4.4E-10	27	N/A	--	N/A	--	4.4E-10	27	N/A	--	N/A	--
RCPVC	4	4.4E-10	27	N/A	--	4.4E-10	27	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27
RCQGC	4	4.4E-10	27	N/A	--	4.4E-10	27	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27
RCQVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27
RCRGC	4	4.5E-10	21	N/A	--	4.5E-10	21	N/A	--	4.5E-10	21	N/A	--	N/A	--	4.5E-10	21
RCRVC	4	4.5E-10	21	N/A	--	4.5E-10	21	N/A	--	4.5E-10	21	N/A	--	N/A	--	4.5E-10	21
RCBGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-10	47
RCKGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHF	5	3.5E-10	47	3.5E-10	47	N/A	--	N/A	--	3.5E-10	47	N/A	--	N/A	--	3.5E-10	47

See notes at end of table.

TABLE 8-34 (Continued)

Accident Frequencies and Range Factors

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR
RCKVF	5	N/A	--	N/A	--	N/A	--	3.5E-10	47	N/A	--	N/A	--	N/A	--	N/A	--
RCSVF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-10	47
RCBGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20
RCDHC	6	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--
RCCGC	6	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHC	6	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--
RCKGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHS	6	1.7E-11	20	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20
RCKVS	6	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--
RCMVC	6	1.7E-11	20	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20
RCPGC	6	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20
RCFHC	6	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--
RCPVC	6	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20
RCQGC	6	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20
RCQVC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20
RCRGC	6	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20
RCRVC	6	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20
RCSVS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20
RCBGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20
RCDHC	7	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--
RCCGC	7	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHC	7	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--
RCKGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHF	7	1.4E-11	20	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20
RCKVF	7	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--
RCMVC	7	1.4E-11	20	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20
RCPGC	7	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20
RCPHC	7	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--
RCPVC	7	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20
RCQGC	7	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20

See notes at end of table.

TABLE 8-34 (Continued)

Accident Frequencies and Range Factors

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR
RCQVC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20
RCRGC	7	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20
RCRVC	7	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20
RCSVF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20
RCBGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37
RCDHS	11	1.4E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-07	37	N/A	--	N/A	--
RCCGS	11	1.4E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHS	11	1.4E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-07	37	N/A	--	N/A	--
RCKGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHS	11	1.4E-07	37	1.1E-07	37	N/A	--	N/A	--	1.6E-07	37	N/A	--	N/A	--	4.8E-07	37
RCKVS	11	N/A	--	N/A	--	N/A	--	1.3E-07	37	N/A	--	N/A	--	N/A	--	N/A	--
RCMVS	11	1.4E-07	37	N/A	--	N/A	--	N/A	--	1.6E-07	37	N/A	--	N/A	--	4.8E-07	37
RCPGS	11	1.4E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37
RCPHS	11	1.4E-07	37	N/A	--	3.0E-07	37	N/A	--	N/A	--	1.5E-07	37	N/A	--	N/A	--
RCPVS	11	1.4E-07	37	N/A	--	3.0E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37
RCQGS	11	1.4E-07	37	N/A	--	3.0E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37
RCQVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37
RCRGS	11	1.4E-07	37	N/A	--	3.0E-07	37	N/A	--	1.6E-07	37	N/A	--	N/A	--	4.8E-07	37
RCRVS	11	1.4E-07	37	N/A	--	3.0E-07	37	N/A	--	1.6E-07	37	N/A	--	N/A	--	4.8E-07	37
RCSVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37
RCDHC	12	1.6E-08	96	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	10	N/A	--	N/A	--
RCCGC	12	1.6E-08	96	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHC	12	1.6E-08	96	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	10	N/A	--	N/A	--
RCMVC	12	1.6E-08	105	N/A	--	N/A	--	N/A	--	1.7E-08	61	N/A	--	N/A	--	5.3E-08	71
RCPGC	12	1.5E-08	100	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73
RCPHC	12	1.5E-08	100	N/A	--	3.2E-08	105	N/A	--	N/A	--	1.6E-08	100	N/A	--	N/A	--
RCPVC	12	1.5E-08	100	N/A	--	3.2E-08	105	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73
RCQGC	12	1.5E-08	100	N/A	--	3.2E-08	105	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73
RCQVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73
RCRGC	12	1.6E-08	86	N/A	--	3.3E-08	86	N/A	--	1.7E-08	86	N/A	--	N/A	--	5.4E-08	86

See notes at end of table.

TABLE 8-34 (Continued)

Accident Frequencies and Range Factors

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	AFG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR
RCRVC	12	1.6E-08	86	N/A	--	3.3E-08	86	N/A	--	1.7E-08	86	N/A	--	N/A	--	5.4E-08	86
RCBGF	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	89
RCKGF	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHF	13	1.5E-08	107	1.2E-08	118	N/A	--	N/A	--	1.7E-08	82	N/A	--	N/A	--	5.1E-12	89
RCKVF	13	N/A	--	N/A	--	N/A	--	1.4E-08	69	N/A	--	N/A	--	N/A	--	N/A	--
RCSVF	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	89
RCBGS	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76
RCDHC	14	4.5E-08	87	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	91	N/A	--	N/A	--
RCCGC	14	4.5E-08	87	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHC	14	4.5E-08	87	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	91	N/A	--	N/A	--
RCKGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHC	14	4.5E-08	87	4.0E-08	23	N/A	--	N/A	--	4.2E-08	95	N/A	--	N/A	--	1.9E-10	76
RCKVC	14	N/A	--	N/A	--	N/A	--	3.9E-08	120	N/A	--	N/A	--	N/A	--	N/A	--
RCMVC	14	4.5E-08	87	N/A	--	N/A	--	N/A	--	4.2E-08	95	N/A	--	N/A	--	1.9E-10	76
RCPGC	14	4.5E-08	87	N/A	--	N/A		N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76
RCPHC	14	4.5E-08	87	N/A	--	4.3E-08	80	N/A	--	N/A	--	2.2E-10	91	N/A	--	N/A	--
RCPVC	14	4.5E-08	87	N/A	--	4.3E-08	80	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76
RCQGC	14	4.5E-08	87	N/A	--	4.3E-08	80	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76
RCQVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76
RCRGC	14	4.5E-08	87	N/A	--	4.3E-08	80	N/A	--	4.2E-08	95	N/A	--	N/A	--	1.9E-10	76
RCRVC	14	4.5E-08	87	N/A	--	4.3E-08	80	N/A	--	4.2E-08	95	N/A	--	N/A	--	1.9E-10	76
RCSVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76
RCDHC	15	5.2E-09	73	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-09	83	N/A	--	N/A	--
RCCGC	15	5.2E-09	73	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHC	15	5.2E-09	73	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-09	83	N/A	--	N/A	--
RCMVC	15	5.2E-09	73	N/A	--	N/A	--	N/A	--	5.5E-09	91	N/A	--	N/A	--	1.3E-08	117
RCPGC	15	5.2E-09	73	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117
RCPHC	15	5.2E-09	73	N/A	--	9.4E-09	82	N/A	--	N/A	--	4.1E-09	83	N/A	--	N/A	--
RCPVC	15	5.2E-09	73	N/A	--	9.4E-09	82	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117
RCQGC	15	5.2E-09	73	N/A	--	9.4E-09	82	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117

See notes at end of table.

TABLE 8-34 (Continued)

Accident Frequencies and Range Factors

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR
RCQVC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117
RCRGC	15	5.2E-09	73	N/A	--	9.4E-09	82	N/A	--	5.5E-09	91	N/A	--	N/A	--	1.3E-08	117
RCRVC	15	5.2E-09	73	N/A	--	9.4E-09	82	N/A	--	5.5E-09	91	N/A	--	N/A	--	1.3E-08	117

NOTES: 1. Scenarios 1-5 are per train mile; scenarios 6-15 are per exposure year.

2. Duration time shown for scenarios with agent releases due to detonations and spills is for spill only. Duration time for detonation is instantaneous.

TABLE 8-35

OFFSITE TRANSPORTATION - REGIONAL DISPOSAL OPTION

Accident Frequencies and Range Factors

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR
RCBGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10
RCDHS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--
RCCGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--
RCKGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHS	3	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10
RCKVS	3	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--
RCMVS	3	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10
RCPGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10
RCPHS	3	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--
RCPVS	3	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10
RCQGS	3	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10
RCQVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10
RCRGS	3	N/A	--	N/A	--	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10
RCRVS	3	N/A	--	N/A	--	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10
RCSVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10
RCDHC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	23	N/A	--	N/A	--
RCCGC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	23	N/A	--	N/A	--
RCMVC	4	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	21	N/A	--	N/A	--	4.4E-10	21
RCPGC	4	N/A	--	N/A	--	N/A		N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27
RCPHC	4	N/A	--	N/A	--	4.4E-10	27	N/A	--	N/A	--	4.4E-10	27	N/A	--	N/A	--
RCPVC	4	N/A	--	N/A	--	4.4E-10	27	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27
RCQGC	4	N/A	--	N/A	--	4.4E-10	27	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27
RCQVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27
RCKGC	4	N/A	--	N/A	--	4.5E-10	21	N/A	--	4.5E-10	21	N/A	--	N/A	--	4.5E-10	21
RCRVC	4	N/A	--	N/A	--	4.5E-10	21	N/A	--	4.5E-10	21	N/A	--	N/A	--	4.5E-10	21
RCBGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-10	47
RCKGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--

See notes at end of table.

TABLE 8-35 (Continued)

OFFSITE TRANSPORTATION - REGIONAL DISPOSAL OPTION

Accident Frequencies and Range Factors

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR
RCKHF	5	N/A	--	3.5E-10	47	N/A	--	N/A	--	3.5E-10	47	N/A	--	N/A	--	3.5E-10	47
RCKVF	5	N/A	--	N/A	--	N/A	--	3.5E-10	47	N/A	--	N/A	--	N/A	--	N/A	--
RCSVF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-10	47
RCBGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20
RCDHC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--
RCCGC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--
RCKGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHS	6	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20
RCKVS	6	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--
RCMVC	6	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20
RCPGC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20
RCPHC	6	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--
RCPVC	6	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20
RCQGC	6	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20
RCQVC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20
RCRGC	6	N/A	--	N/A	--	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20
RCRVC	6	N/A	--	N/A	--	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20
RCSVS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20
RCBGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20
RCDHC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--
RCCGC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--
RCKGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHF	7	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20
RCKVF	7	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--
RCMVC	7	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20
RCPGC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20
RCPHC	7	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--

See notes at end of table.

TABLE 8-35 (Continued)

OFFSITE TRANSPORTATION - REGIONAL DISPOSAL OPTION

Accident Frequencies and Range Factors

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR
RCPVC	7	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20
RCQGC	7	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20
RCQVC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20
RCRGC	7	N/A	--	N/A	--	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20
RCRVC	7	N/A	--	N/A	--	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20
RCSVF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20
RCBGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37
RCDHS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-07	37	N/A	--	N/A	--
RCCGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-07	37	N/A	--	N/A	--
RCKGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHS	11	N/A	--	1.1E-07	37	N/A	--	N/A	--	3.1E-07	37	N/A	--	N/A	--	4.8E-07	37
RCKVS	11	N/A	--	N/A	--	N/A	--	1.7E-07	37	N/A	--	N/A	--	N/A	--	N/A	--
RCMVS	11	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-07	37	N/A	--	N/A	--	4.8E-07	37
RCPGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37
RCPHS	11	N/A	--	N/A	--	1.6E-07	37	N/A	--	N/A	--	1.5E-07	37	N/A	--	N/A	--
RCPVS	11	N/A	--	N/A	--	1.6E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37
RCQGS	11	N/A	--	N/A	--	1.6E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37
RCQVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37
RCRGS	11	N/A	--	N/A	--	1.6E-07	37	N/A	--	3.1E-07	37	N/A	--	N/A	--	4.8E-07	37
RCRVS	11	N/A	--	N/A	--	1.6E-07	37	N/A	--	3.1E-07	37	N/A	--	N/A	--	4.8E-07	37
RCSVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37
RCDHC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	10	N/A	--	N/A	--
RCCGC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	10	N/A	--	N/A	--
RCMVC	12	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-08	51	N/A	--	N/A	--	5.3E-08	71
RCPGC	12	N/A	--	N/A	--	N/A		N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73
RCFHC	12	N/A	--	N/A	--	1.8E-08	87	N/A	--	N/A	--	1.6E-08	100	N/A	--	N/A	--
RCPVC	12	N/A	--	N/A	--	1.8E-08	87	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73

See notes at end of table.

TABLE 8-35 (Continued)

OFFSITE TRANSPORTATION - REGIONAL DISPOSAL OPTION

Accident Frequencies and Range Factors

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR
RCQGC	12	N/A	--	N/A	--	1.8E-08	87	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73
RCQVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73
RCRGC	12	N/A	--	N/A	--	1.8E-08	86	N/A	--	3.4E-08	86	N/A	--	N/A	--	5.4E-08	86
RCRVC	12	N/A	--	N/A	--	1.8E-08	86	N/A	--	3.4E-08	86	N/A	--	N/A	--	5.4E-08	86
RCBGF	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	86
RCKGF	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHF	13	N/A	--	1.2E-08	73	N/A	--	N/A	--	3.3E-08	63	N/A	--	N/A	--	1.6E-08	86
RCKVF	13	N/A	--	N/A	--	N/A	--	1.9E-08	64	N/A	--	N/A	--	N/A	--	N/A	--
RCSVF	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	86
RCBGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76
RCDHC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	91	N/A	--	N/A	--
RCCGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	91	N/A	--	N/A	--
RCKGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCKHC	14	N/A	--	5.4E-08	74	N/A	--	N/A	--	6.1E-08	108	N/A	--	N/A	--	1.9E-10	76
RCKVC	14	N/A	--	N/A	--	N/A	--	6.1E-08	87	N/A	--	N/A	--	N/A	--	N/A	--
RCMVC	14	N/A	--	N/A	--	N/A	--	N/A	--	6.1E-08	108	N/A	--	N/A	--	1.9E-10	76
RCPGC	14	N/A	--	N/A	--	N/A		N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76
RCPHC	14	N/A	--	N/A	--	6.1E-08	85	N/A	--	N/A	--	2.2E-10	91	N/A	--	N/A	--
RCPVC	14	N/A	--	N/A	--	6.1E-08	85	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76
RCQGC	14	N/A	--	N/A	--	6.1E-08	85	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76
RCQVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76
RCRGC	14	N/A	--	N/A	--	6.1E-08	85	N/A	--	6.1E-08	25	N/A	--	N/A	--	1.9E-10	76
RCRVC	14	N/A	--	N/A	--	6.1E-08	85	N/A	--	6.1E-08	25	N/A	--	N/A	--	1.9E-10	76
RCSVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76
RCDHC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-09	83	N/A	--	N/A	--
RCCGC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
RCCHC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-09	83	N/A	--	N/A	--
RCMVC	15	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	67	N/A	--	N/A	--	1.3E-08	117

See notes at end of table.

TABLE 8-35 (Continued)

OFFSITE TRANSPORTATION - REGIONAL DISPOSAL OPTION

Accident Frequencies and Range Factors

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR
RCPGC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117
RCPHC	15	N/A	--	N/A	--	6.1E-09	71	N/A	--	N/A	--	4.1E-09	83	N/A	--	N/A	--
RCPVC	15	N/A	--	N/A	--	6.1E-09	71	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117
RCQGC	15	N/A	--	N/A	--	6.1E-09	71	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117
RCQVC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117
RCRGC	15	N/A	--	N/A	--	6.1E-09	71	N/A	--	1.0E-08	67	N/A	--	N/A	--	1.3E-08	117
RCRVC	15	N/A	--	N/A	--	6.1E-09	71	N/A	--	1.0E-08	67	N/A	--	N/A	--	1.3E-08	117

NOTES: 1. Scenarios 1-5 are per train mile; scenarios 6-15 are per exposure year.

2. Duration time shown for scenarios with agent releases due to detonations and spills is for spill only. Duration time for detonation is instantaneous.

8.3. OFFSITE AIR TRANSPORT

The purpose of this section is to evaluate the accident sequences associated with specific air transportation transfers. The results, in terms of frequency of chemical agent release, will be combined with agent release and consequence calculations to determine the risk of the air transportation option and to compare the relative risk of the air option with other transportation alternatives.

The transfers involve transport of chemical agent munitions from both Aberdeen Proving Ground and Lexington Depot to Tooele Depot via a C-141 aircraft. Also, the analysis was carried through for a C-5 aircraft. The air flight distances planned for the air transport phases are 1540 and 2066 miles from Lexington and Aberdeen, respectively (Ref. 8-15). The specific route taken for air transport flights avoids flying directly over major population centers.

The actual number of flights to be performed during the air transport operation is classified information. However, the draft concept plan (Ref. 8-16) states that approximately 1500 flights from Lexington and about 300 flights from Aberdeen will be required for a C-141 aircraft. A C-5 aircraft would decrease the number of required flights by one-fourth.

All munitions will be transported inside an offsite transport container (OFC), designed to meet special chemical munition criteria so that it will not fail as a result of certain severe accident scenarios postulated by a panel of civilian transportation experts. The package failure thresholds are given in Section 3.3.

8.3.1. Procedures and Assumptions

Specific to the air transport mode, it is assumed that a crush or puncture failure cannot occur without first experiencing an impact.

Thus, the frequency data associated with crush and puncture accidents are stated as "crush given impact" and "puncture given impact."

The hypothetical scenario of fuze-induced detonation ofburstered munitions is not considered credible, (Ref. 8-6). Burster detonation from other initiators, however, is considered.

The Sandia National Laboratory data base (Ref. 8-1) regarding rates of aircraft accidents includes, as components of the data, accidents due to severe weather and midair collisions. Thus, these are not treated as separate events.

The effects of an aircraft depressurization accident are negligible and were not included in the analysis for the following reasons:

1. Only projectiles, rockets, and ton containers are to be transported by air.

2. Projectiles are designed to be projected into high-atmosphere (low-pressure) conditions during normal operation without breaching agent containment. Burster detonation is required to breach designed containment.

3. The ton containers used for transporting mustard agent contain significant voids (they are not full). Ton containers are designed to withstand significant pressure differences between the inside and outside of the package without losing structural integrity. For example, ton containers are commonly used for processing enriched uranium where the inside pressure is essentially a vacuum. Although the pressure difference is in the opposite direction in a plane depressurization accident, no threat exists for a nonleaking ton container during a depressurization scenario.

4. In the case of rockets, static pressure tests (Ref. 8-20) have been performed on rockets similar to those to be transported by air. These rockets were deburstered and defuzed so that failure by heating would occur from static pressure only. Failure occurred at pressures ranging from approximately 700 to 1000 psig and temperatures of 400° to 800°F at heatup times of 20 to 40 min. The scenario postulated is a depressurization at ambient temperatures, with the maximum threat to the agent is approximately 15 psi change in pressure. Based on this data, it is believed that a nonleaking rocket subjected to such a scenario poses no threat.

The planned air route is down the Chesapeake Bay before turning west, but it will not be over any water bodies (lake, river, ocean, etc.) which would have depths greater than the 600-ft design criterion. (Note that the maximum depth of the Chesapeake Bay is about 140 ft.) Therefore, any air accident scenario which includes package failure by immersion into the water is not credible and not included.

The M55 rocket is unique among obsolete chemical weapons in that the propellant is electrically initiated. It is assumed that the rocket pallets will be shielded from electromagnetic or electrostatic sources by a metal container. The OFC design can be evaluated to verify (1) that it completely shields the rockets from electromagnetic and electrostatic sources, (2) that such shielding will withstand any accident condition that would not of itself result in advertent ignition, (3) that administrative controls will be in place to control electromagnetic and electrostatic sources at accident locations, and (4) that portable shielding and grounding systems, as well as training in their use, be made available to accident response teams.

8.3.2. Accident Scenario Definition

An event tree was developed to more clearly define the set of postulated accident sequences starting with the top event of an air accident occuring. Figure 8-11 is the event tree that results from postulating all credible events which might result in agent release for an aircraft accident.

From the event tree, the accident sequences for the air transportation option fall into one of the following general classes or groups of initiating events:

1. Ground collision (severe or moderate).
2. A fire aboard the aircraft.
3. A ground collision (severe or moderate) with a subsequent fire.

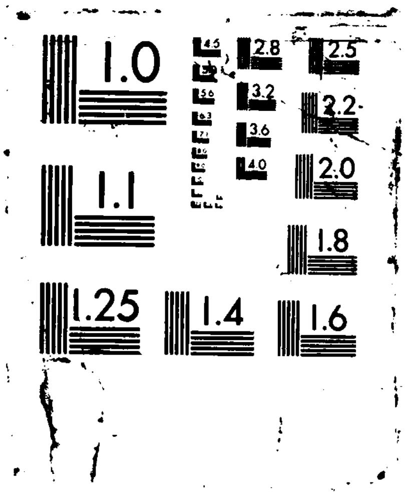
In this report, the failure threats for the packages or packages are the same as those used by Sandia National Laboratories in their analyses of aircraft accidents (Ref. 8-1). This makes it possible to compare the relative frequency of accidents involving the different transportation modes.

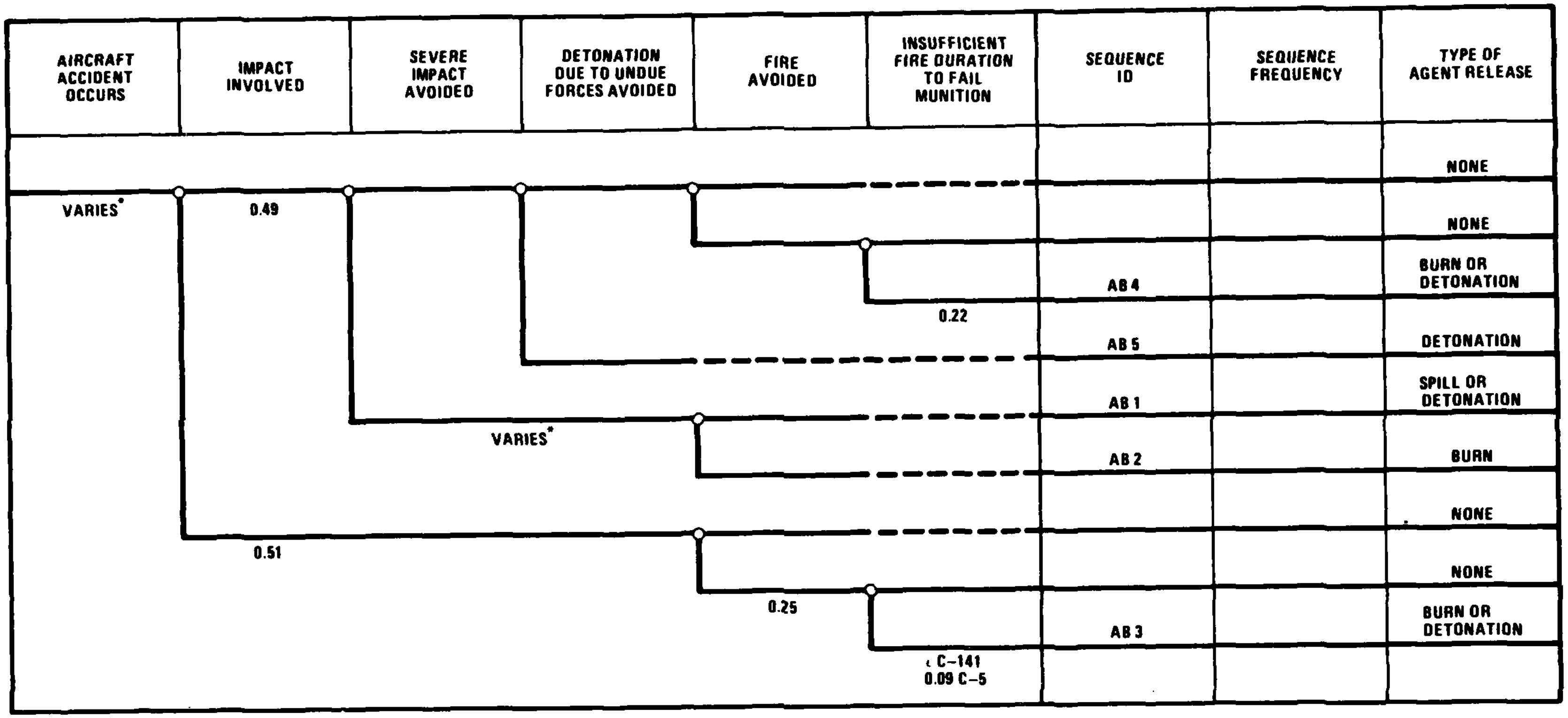
The primary concern is whether the package is breached so that a leak occurs and allows the contained material to escape. Once an accident has occurred, there are five failure threats that can threaten the package and result in chemical agent release. They are:

1. Impact - Striking or being struck by an object which has no sharp projections.

2. Puncture - Striking or being struck by an object which penetrates the protective structures of the package.

AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF 7/13
THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO
CA A W BARSELL ET AL. AUG 87 GA-C-18563
UNCLASSIFIED SAPEO-CDE-IS-87008 DAAA15-85-D-0022 F/G 15/6.3 NL


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6



*VARIES IMPLIES THAT THE VALUE IS A FUNCTION OF FLIGHT PHASE (TAKEOFF, LANDING, INFLIGHT); INITIATING EVENT FREQUENCIES FOR THE FLIGHT PHASES HAVE DIFFERENT UNITS.

Fig. 8-11. Event tree for air transportation

3. <u>Crush</u> - Subjection to structural loads which may be either highly localized or extended over a large area of the package but cannot be categorized as impact, puncture, or immersion.

4. <u>Immersion</u> - Submersion in a liquid medium.

5. <u>Fire</u> - Exposure to a high-temperature environment produced by combustion.

Failure threats of crush, impact, puncture, and fire are applied to the accident scenarios. Estimates of the accident consequences are made to determine the number of agent packages expected to fail, given that some probability exists that their failure thresholds were reached.

The air transport sequence designations are consistent with previous programmatic EIS risk analysis (Ref. 8-21) and are defined in Section 4.1. For this report, the XX designation is "AA" or "AB" for air transportation of agent munitions in OFCs within C-5 and C-141 aircraft, respectively.

Table 8-36 lists the accident sequences for air transport to Tooele Army Depot. Utilizing all combinations of the munitions and agent types with the five basic sequence groupings yields a total of 35 possible accident sequences (5 x 7 matrix) from both sites.

8.3.3. <u>Accident Sequence Analysis</u>

In order to evaluate the accident frequency of agent release from air transport, several quantities must be determined. These quantities include the failure threshold of the package for each threat to be investigated, the frequency that each of these failure thresholds would occur, and the frequency that each threat being investigated would occur. These quantities are then utilized to perform a logical calculation procedure as specified by Boolean algebra. This section presents

TABLE 8-36
ACCIDENT SCENARIOS FOR AIR TRANSPORT TO TOOELE ARMY DEPOT

AB1 AA1	-	A severe ground collision involving an aircraft with munitions occurs and impact forces fail the agent package and munitions.
AB2 AA2	-	A severe ground collision involving an aircraft with munitions occurs and impact forces fail the agent package and munitions. A subsequent fire occurs with a duration less than 2 h.
AB3 AA3	-	A fire occurs aboard an aircraft with munitions and causes rupture of the containment due to thermal expansion of the agent.
AB4 AA4	-	A moderate ground collision involving an aircraft with munitions occurs and impact forces do not fail the agent package and munitions. A subsequent fire occurs with a duration greater than 2 h.
AB5 AA5	-	A moderate ground collision involving an aircraft with munitions occurs causing detonation of burstered munitions and a breach of the package. For rockets, the detonation could also arise from impact induced motor ignition.

each fundamental quantity used in the calculational sequence and the results of the calculation.

8.3.3.1. Air Transport Data Base and Analysis.

8.3.3.1.1. Fire-Related Probabilities. From the SNL report (Ref. 8-1), the following quantities are of interest in fire-related air transportation accidents:

Fraction of military air accidents which involve fire = 0.35.

Fraction of military air accidents which involve impact and fire = 0.22.

If it is assumed that fire accidents are independent of impact accidents, then the following quantity may be determined:

Fraction of military air accidents which involve fire only = 0.13 = 0.35 - 0.22.

Assuming that fire accidents are independent of impact accidents in air transportation is not completely valid. An estimate of the error in this assumption can be made by realizing that the fraction of all air accidents which involve impact is 0.49 and which involve fire is 0.35 (from above). If the problem were completely linear, the fraction of air accidents which involve impact and fire would be (0.49) (0.35) = 0.17. But, in fact, the actual fraction of air accidents which involve fire and impact is 0.22 (from above) which demonstrates the nonlinearity of the problem. In this risk analysis, it is assumed that the relative frequencies are separable as shown above (0.13 = 0.35 - 0.22). This assumption is necessary due to the method in which the frequency data is made available. The uncertainty associated with this assumption is no worse than the uncertainty associated with the original data base itself.

Figure 8-12 (from the SNL report) indicates that the maximum fire duration for the C-141 and C-5 aircrafts is 90 and 130 min, respectively. Figure 8-12 is used to determine the failure probabilities due to fire.

Also from SNL report, the expected mean temperature from the probability distribution function for the fire temperature of an air accident fire is approximately 1850°F. Furthermore, the minimum temperature is approximately 1400°F (the minimum burn temperature of JP-4 fuel).

8.3.3.1.2. Impact-Related Probabilities. From SNL report (Ref. 8-1), the following quantities are of interest in impact related air transportation accidents:

Fraction of military air accidents which involve impact = 0.49.

Fraction of military air accidents which involve impact and fire = 0.22.

A similar argument as before (fire-related probabilities) allows that an accident involving impact alone (without fire) may be estimated to have a frequency of:

Fraction of military air accidents which involve impact only = 0.27 = 0.49 - 0.22.

Table 8-37 shows the distribution of 149 impact accidents by military aircraft (Ref. 8-1) into landing, takeoff, and inflight. The package will be designed for a deceleration of 35 g. Analyses of potential g forces in aircraft accidents show that for impact angles less than about 10 deg, the cargo would see less than 35 g. Based on 96 military accidents, the percentage of accidents occurring at crash angles less than 10 deg are 85% for takeoff, 87% landing, and 30%

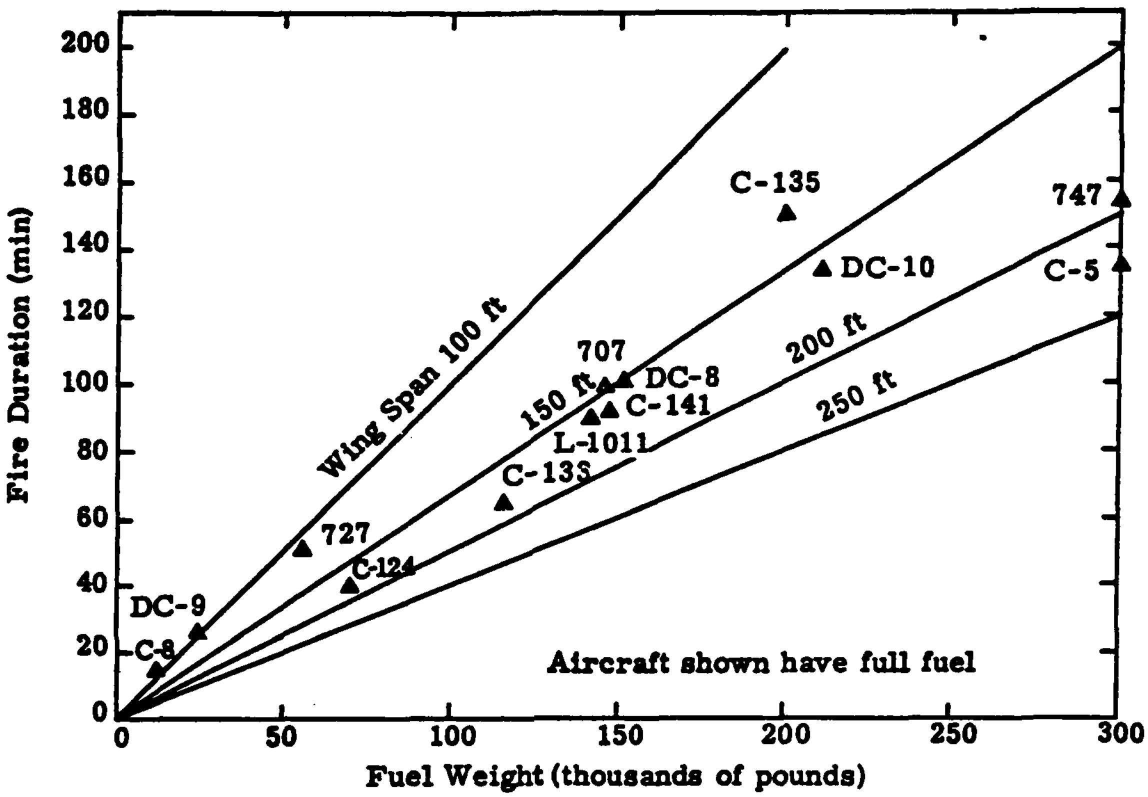


Fig. 8-12. Approximate duration of fuel fire as a function of aircraft size and on-board fuel inventory

TABLE 8-37
DISTRIBUTION OF AIRCRAFT ACCIDENT IMPACT CATEGORIES

Flight Phase		Percentage of Accidents
Landing		87/149 = 0.58
Takeoff		14/149 = 0.09
Inflight		48/149 = 0.32
Stalls at an altitude greater than 200 ft	9	
Inflight	26	
Lost at sea	6	
Breakup above 5000 ft	4	
Severe and unknown	3	
	48	0.99

inflight (Ref. 8-7). Thus, the fraction of accidents which are considered to fail the package is the complement of above values, i.e., 1 - 0.85 = 0.15 for takeoff.

8.3.3.1.3. Puncture-Related Probabilities. The SNL data base (Ref. 8-1) considered puncture from ground or water collision and from fragments, e.g., turboprop blades, which might enter the cargo compartment without collision. Approximately 6% of all military aircraft accidents could result in a cargo puncture threat. SNL did not characterize the magnitude of the cargo puncture environment, i.e., given a puncture threat, the frequency cargo will in fact experience a puncture, because 97.1% of the puncture events either involve an impact threat or the puncture threat is considered relatively benign. However, in 2.9% of the accidents, a missile passed entirely through the cargo compartment; the report did not specify whether any cargo was struck. One percent were combat related; therefore, 1.9% of military aircraft accidents of interest could be considered as causing cargo puncture in the absence of other forces.

The consequences of puncture threats are essentially the same as the consequences of impact threats; therefore, neglecting the puncture threat relative to the impact threat introduces an error of only about 2%.

8.3.3.1.4. Crush-Related Probabilities. The SNL data base (Ref. 8-1) reports a value of 0.05 as the fraction of military impact accidents which also involve crush. Crush is assumed as being possible only in impact accidents. The crush strength of the OFC package is specified in Table 3-1 as 520,000 lb. The SNL aircraft model predicted that crush forces onto the cargo could occur either by (1) crushes from adjacent cargo or by (2) crush due to the aircraft frame. Since only one package is aboard the C-141, a crush from adjacent cargo is not credible. On the C-5 aircraft, there are not enough packages on board to provide sufficient weight to crush a single package. In order for

the aircraft itself to crush the cargo, it must be broken into parts. SNL suggests that the most likely weight of a major broken piece to be less than 80,000 lb. This is well below the OFC package crush threshold, and the crush threat to the cargo can be neglected, particularly in comparison to the impact threat.

8.3.3.1.5. Frequency of an Air Accident. Recent communication with the U.S. Air Force has established specific accident rates for the C-141 and C-5 aircraft as of May 1987. An aircraft accident is defined by the Air Force as any aircraft mishap, occurring when there is intent for flight, which results in aircraft damage. Class A accidents are currently defined as accidents producing damage in excess of $500,000, and the data presented below are for Class A accidents. Data for other accident classes may be useful for the "detonation from undue force" event and have been requested from the Air Force.

The accident rate for the C-141 aircraft, is 10 per 5,116,997 flying hours and 2,952,489 landings for the years 1971 through early 1987 (Ref. 8-12). The data presented in Table 8-38 for impact and impact plus fire accidents will be assumed to apply also to fire only accidents; thus, a separate accident rate can be determined for takeoff, inflight, and landing as:

3.0×10^{-7} takeoff accidents/flight
2.0×10^{-6} landing accidents/flight
6.2×10^{-7} inflight accidents/hour

Assuming an average flight speed of 500 mph:

$$\text{Inflight accident rate for C-141 aircraft} = \frac{6.2 \times 10^{-7}}{\text{flying hour}} \times \frac{1\ \text{h}}{500\ \text{miles}} \times d\ (\text{miles})$$

$$= [(1.2 \times 10^{-9})\ d]\ \text{inflight accidents/flight}$$

where d is the flight distance in miles.

For the C-5 aircraft, the accident rate is 1.6×10^{-5}/h (Ref. 8-22). Assuming that the average hours per flight for the C-5 is the same as the C-141, the following accident distribution is obtained using the data in Table 8-38:

2.5×10^{-6} takeoff accidents/flight
1.6×10^{-5} landing accidents/flight
5.2×10^{-6} inflight accidents/hour

Assuming an average flight speed of 500 mph results in an inflight accident rate of 1.0 x 10-8 accidents/mile.

Table 8-38 summarizes the fraction of aircraft accidents involving impact and fire. It also gives the inflight accident frequencies for specific site transfers, based on the air route mileages and estimated flight times (Ref. 8-6).

8.3.3.2. Failure Thresholds.

8.3.3.2.1. Thermal Thresholds. As stated above, all munitions are to be transported in an OFC package. One package design criterion is that after a 2 h, totally engulfing fire, the bulk agent and propellant temperatures of a M55 rocket are 250° and 400°F, respectively. However, if the fire threat is preceded by another threat, such as impact, then the 2-h value is reduced to 0.5 h. In the above temperature situation, the munition burster is on the threshold of detonation, and detonation is assumed to fail the package. Munitions without a burster might fail due to high agent pressure; however, such failure probably would not cause failure of the package. Due to the lack of specific package design information; however, the package and contained munitions (with or without burster) are assumed to fail after a 2-h fire.

Since the fuel on a C-141 aircraft can be expected to burn no longer than 90 min, no release can be expected for a fire-only accident

TABLE 8-38
SUMMARY OF AIRCRAFT ACCIDENT THREAT FREQUENCY DATA

Fraction of accidents producing impact	0.49
Fraction of accidents producing fire	0.35
Fraction of accidents producing fire and impact	0.22
Fraction of accidents producing fire only	0.13
Fraction of accidents producing impact only	0.27
Fraction of accidents exceeding package impact criteria	
Takeoff (1-0.85)	0.15
Inflight (1-0.30)	0.70
Landing (1-0.87)	0.13
C-5 accident rates (accidents per flight)	
Takeoff	2.5×10^{-6}
Inflight (APG)	2.1×10^{-5}
Inflight (LBAD)	1.5×10^{-5}
Landing	1.6×10^{-5}
C-141 accident rates (accidents per flight)	3.0×10^{-7}
Takeoff	2.5×10^{-6}
Inflight (APG)	1.8×10^{-6}
Inflight (LBAD)	1.8×10^{-6}
Landing	2.0×10^{-6}

(probability of zero). On the other hand, the fuel on the C-5 aircraft is expected to burn for a period of up to 130 min, and the possibility of release given a fire without impact must be considered. It is assumed that enough C-5 fuel is consumed during takeoff and attaining cruising altitude that the maximum fire duration is reduced to less than 120 min; thus, the possibility of fires lasting more than 2 h is restricted to takeoff accidents only.

For accidents involving impact and fire, either type of aircraft can result in an agent release because only 30-min fire protection is available after the impact. The aircraft will be required to land at TEAD with fuel for at least 45 min of flying time; thus, the possibility of a 30-min fire is considered to exist for all phases of the flight; however, in general only 22% of all aircraft fires last at least 30 min.

Although aircraft fuel is not the only combustible material on board, only fuel fires are considered to challenge the package, i.e., an engulfing fire of 1850°F.

8.3.3.2.2. Mechanical Thresholds. The OFC package is being designed to withstand a deceleration of 35 g. The spectrum of aircraft impact severities is considered in two portions: one for impact severities less than 35 g which do not produce a direct impact package failure, and the second for all impact severities greater than 35 g. The projectiles are expected to fail at impact forces substantially higher than those producing failure for the package; thus, the 35-g division criterion is conservative for projectiles.

Tests with rockets packaged only in the fiberglass shipping tubes showed that impact can cause rocket motor ignition for drops from 40 ft onto a cement test pad (Ref. 8-5). Palletizing the munitions and enclosing the pallets in a package should significantly reduce the frequency of impact-induced ignitions. Without specific data for the extent of mitigation, the frequency for unpalletized rockets will be

used, 0.044 ignitions per 40-ft drop. An impact less than the equivalent of a 40-ft drop can be expected in 54% of all aircraft accidents (Ref. 8-1). The accident sequence in which this parameter is being used (No. 4) starts with an impact under 35 g. Thus, the 0.44 frequency of failure applies to impacts greater than 40 ft, but less than 35 g. The fraction of accidents in this impact range is approximated as follows:

Takeoff - 0.85 less than 35 g minus 0.54 less than 40 ft results in 0.31 in the desired range.

Inflight - Conservatively assume that all of the 0.30 fraction less than 35 g result in greater than 40-ft impact.

Landing - 0.87 less than 35 g minus 0.54 less than 40 ft results in 0.33 in the desired range.

8.3.3.3. Sequence Frequency Analysis. The frequencies of the accident sequences listed in Table 8-36 were evaluated as described in Tables 8-39 through 8-43.

To compute the frequency of occurrence of an accident in a particular area around a particular takeoff (or landing) site, e.g., the Chesapeake Bay, multiply the takeoff (or landing) frequency from Section 8.3.3.1.5 by the fractional exposure time to the particular area. For example, if 80% of the takeoffs at APG are in the direction of the bay, one multiplies the takeoff value by 0.8. Results of the accident sequence frequencies are summarized in Table 8-44.

TABLE 8-39
AIR TRANSPORT SEQUENCE 1

AB1 - An aircraft crash occurs in which the package and munitions
AA1 are subjected primarily to impact forces. The impact forces are categorized as sufficiently severe to fail the package and munitions.

Frequency Factors to be Multiplied	Value		Reference/Remarks
Accident rate per flight	Varies		Table 8-38
Impact is the only force occurring	0.27		Table 8-38
Impact force fails package	Takeoff	0.15	Table 8-38
	Inflight	0.70	
	Landing	0.13	

TABLE 8-40
AIR TRANSPORT SEQUENCE 2

AB2 - An aircraft crash occurs in which the package and munitions
AA2 are subjected primarily to impact forces sufficient to fail the package and munitions. Fire occurs and involves agent.

Frequency Factors to be Multiplied	Value		Reference/Remarks
Accident rate per flight	Varies		Table 8-38
Impact and fire occur	0.22		Table 8-38
Impact force fails package	Takeoff	0.15	Table 8-38
	Inflight	0.70	
	Landing	0.13	

TABLE 8-41
AIR TRANSPORT SEQUENCE 3

AB3 - A fire occurs on an aircraft. The package and munitions fail
AA3 from thermal forces.

Frequency Factors to be Multiplied	Value	Reference/Remarks
Accident rate per flight	Varies	Table 8-38
Fire is the only force occurring	0.13	Table 8-38
Fire duration (2 h) sufficient to fail package/munitions	ϵ for C-141 0.09 for C-5	Insufficient fuel. Takeoff only (conservatively assumes fire will last 2 h if started)

TABLE 8-42
AIR TRANSPORT SEQUENCE 4

AB4 - An aircraft crash occurs, but the impact forces are not suf-
AA4 ficient to fail the package. Fire also occurs, and thermal forces fail the package and munitions.

Frequency Factors to be Multiplied	Value		Reference/Remarks
Accident rate per flight	Varies		Table 8-38
Impact and fire occur	0.22		Table 8-38
Impact force does not fail package	Takeoff Inflight Landing	0.85 0.30 0.87	Table 8-38
Fire duration (30 min) sufficient to fail package/munitions	0.22		Ref. 8-1, even though sufficient fuel available in all flight phases

TABLE 8-43
AIR TRANSPORT SEQUENCE 5

AB5 - An aircraft crash occurs, but the impact forces are not
AA5 sufficient to fail the package directly. For rockets, the impact may cause motor ignition. For burstered munitions, the undue force causes detonation.

Frequency Factors to be Multiplied	Value		Reference/Remarks
Accident rate per flight	Varies		Table 8-38
Impact occurs	0.49		Table 8-38
Impact force is not severe	Takeoff	0.85	Table 8-38
	Inflight	0.30	
	Landing	0.87	
Undue force detonates burster	2.1×10^{-3}		Ref. 8-6
Impact causes rocket motor ignition	0.044		Ref. 8-5
Impact greater than 40 ft	Takeoff	0.31	Also less than 35 g
	Inflight	0.30	
	Landing	0.33	

TABLE 8-44
SEQUENCE FREQUENCIES[(a)] FOR AIR TRANSPORTATION

Flight Orig.	Sequence Number	Sequence Description	C-141			C-5		
			Takeoff	Inflight	Landing	Takeoff	Inflight	Landing
APG	1	Severe impact	1.2×10^{-8}	4.7×10^{-7}	7.0×10^{-8}	1.0×10^{-7}	4.0×10^{-6}	5.6×10^{-7}
APG	2	Severe impact + fire	9.9×10^{-9}	3.8×10^{-7}	5.7×10^{-8}	8.2×10^{-8}	3.2×10^{-6}	4.6×10^{-7}
APG	3	Fire during takeoff	0	0	0	2.9×10^{-8}	0	0
APG	4	Moderate impact + fire	1.2×10^{-8}	3.6×10^{-8}	8.4×10^{-8}	1.0×10^{-7}	3.0×10^{-7}	6.7×10^{-7}
APG	5	Moderate impact/undue force	0	0	0	0	0	0
LBAD	1	Severe impact	1.2×10^{-8}	3.4×10^{-7}	7.0×10^{-8}	1.0×10^{-7}	2.8×10^{-6}	5.6×10^{-7}
LBAD	2	Severe impact + fire	9.9×10^{-9}	2.8×10^{-7}	5.7×10^{-8}	8.2×10^{-8}	2.3×10^{-6}	4.6×10^{-7}
LBAD	3	Fire during takeoff	0	0	0	2.9×10^{-8}	0	0
LBAD	4	Moderate impact + fire	1.2×10^{-8}	2.6×10^{-8}	8.4×10^{-8}	1.0×10^{-7}	2.2×10^{-7}	6.7×10^{-7}
LBAD	5[(b)]	Moderate impact/undue force	2.6×10^{-10}	5.6×10^{-10}	1.8×10^{-9}	2.2×10^{-9}	4.6×10^{-9}	1.4×10^{-8}

(a) Per flight.
(b) For rockets, increase by a factor of 7.4.

8.4. OFFSITE MARINE TRANSPORT

The purpose of this section is to analyze the accident scenarios associated with the specific option of transporting mustard-filled ton containers from Aberdeen Proving Ground (APG), Maryland, by ship to the Johnston Atoll Army site in the Pacific Ocean where they will be disposed of along with the chemical munitions inventory currently stored on the atoll. Vaults will be used as the transport packing concept, instead of the OFCs used for rail.

8.4.1. Procedures, Assumptions, and Data

The information required to develop the frequency of accidents and the conditional probabilities is taken from the data collected on past marine transportation accidents. Data is compiled from the U.S. Coast Guard Commercial Vessel Safety File, Lloyds Weekly Casualty Reports, the National Transportation Safety Board Reports, and from individual port authority and maritime exchange records. Specific information is available for the LASH ship or ships of similar size and is used to provide the accident frequencies and conditional probabilities for the events. The computer model developed by Engineering Computer Optecnomics, Incorporated (ECO) is then used to integrate the ship specific information with all specific operating situations to obtain the overall accident frequency (Ref. 8-25).

The offsite marine transportation option is modeled by dividing the specific route into hundreds of small segments called port elements. Within each port element, the frequency and conditional probabilities are evaluated. This is done by taking the specific vessel under consideration and interacting that vessel with the situational parameters such as the actual channel configuration and geometry; the water depths, the presence, characteristics, and proximity of fixed or floating obstacles; and any operating factors under which the vessel will be operating, such as tug boat assistance or daylight operations. The results from each

port element are then aggregated to produce the overall frequency per trip.

In this model, it is the integration of the specific vessel historic incidence rates on a port element by port element basis with the interaction of the specific ship and all specific situational and operating parameters which permit the model to estimate the probability that an accident will occur. For example, if the interaction of the specific vessel with the water depth in a given port element shows water depths too deep (relative to the vessel's draft plus some margin for underkeel clearance) to have a grounding, then a zero value will result for groundings within that particular port element. As another example, if the occurrence of fixed or floating obstacles within a given port element is high, then the interaction analysis will result in an increased ramming incidence rate. On the other hand, the presence of a U.S. Coast Guard escort will tend to mitigate collision occurrences. The use of tug boats will tend to provide added controllability to a ship and thus reduce the occurrence of rammings and groundings.

It is assumed that the munitions will be transported in a vault with failure thresholds as specified in Table 3-1.

8.4.2. Accident Sequence Definition and Analysis

The accident scenarios for the marine transportation option fall into one of the following families or groups of initiating events:

1. Collisions with other vessels, aircraft, or other moving objects.

2. Rammings, defined as collisions with fixed objects (i.e., piers, bridges, anchored, or moored vessels or aids to navigation) or collisions with icebergs, ice fields, or other floating objects moving with a velocity that is relatively slow compared to the striking vessel velocity.

3. Groundings in shallow areas.

4. On-board fire/explosions.

5. Structural failure due to heavy weather such as high winds, hurricanes, tsunamis, etc.

6. Aircraft crash into the marine vessel.

These initiating event families correspond to the primary or basic events. Subsequent events, such as fire, show up in the scenarios as conditional events. For example, a fire scenario may be one in which the fire, perhaps originating from spontaneous combustion, is the primary event; however, fire may also be a conditional event if it results from a collision.

Once any accident has occurred, the vault and the munition inside have five modes of failure which could be produced and result in chemical agent release. These failure modes are defined below:

1. Impact - striking or being struck by an object which has no sharp projections.

2. Puncture - striking or being struck by an object which penetrates the protective structures of the container.

3. Crush - subjection to structural loads which may be either highly localized or extended over a large area of the container but cannot be categorized as impact, puncture, or immersion.

4. Immersion - submersion in a liquid medium.

5. Fire - exposure to a high-temperature environment produced by combustion.

In the case of marine transportation, impact and puncture are not the dominant failure forces experienced in an accident. One reason is that for both the lighter and the ship, the cargo will be adequately braced to hold the cargo in place. The second reason is that the majority of the events are low-velocity, high-momentum events, thus the dominant failure mode is crush. Only the failure modes crush, immersion, and fire have been examined in this analysis.

The scenarios corresponding to the *six initiating event families* were developed using computer analyses and event trees. Figure 8-13 shows the event tree for vessel collisions. Similar trees apply to the other initiating event families.

Once the possible accident sequences were defined, they were assigned an accident scenario identification number according to the coding described in Section 4.1.

For the transport of the mustard-filled ton containers from APG, the marine transportation mode, XX, was broken down into four segments: (1) "BI" for barges in inland waters, (2) "LI" for the ship inland waters, (3) "LC" for the ship in coastal waters, and (4) "LS" for the ship at sea. The main reason for breaking the transportation route into the above segments is that it is necessary to identify not only the transportation vehicle (i.e., barge or ship) but also where the accident occurs such as near population zones, near areas of higher traffic density, or over specific ocean depths.

Initiating Event: Configuration	Initiating Event: Location	Munition Intact	Fire Avoided	Sinking Avoided	Sequence ID	Frequency per Trip	Type of Agent Release
BARGE	INLAND 5.0×10^{-5}	0.9			BIKHS019	–	NONE
		0.1	0.61	ε	BIKHS001	ε	EVAPORATION
				~1	BIKHS002	3.1×10^{-6}	WATER ONLY
			0.39	ε	BIKHC003	ε	BURN
				~1	BIKHC004	2.0×10^{-6}	BURN
LASH	INLAND 1.8×10^{-4}	0.98			LIKHS019	–	NONE
		0.02	0.8	0.95	LIKHS001	2.7×10^{-6}	EVAPORATION
				0.05	LIKHS002	1.4×10^{-7}	WATER ONLY
			0.2	0.95	LIKHC003	6.7×10^{-7}	BURN
				0.05	LIKHC004	3.5×10^{-8}	BURN
	COASTAL 8.1×10^{-5}	0.98			LCKHS019	–	NONE
		0.02	0.8	0.95	LCKHS001	1.2×10^{-6}	EVAPORATION
				0.05	LCKHS002	6.5×10^{-8}	WATER ONLY
			0.2	0.95	LCKHC003	3.1×10^{-7}	BURN
				0.05	LCKHC004	1.6×10^{-8}	BURN
	SEA 1.8×10^{-5}	0.98			LSKHS019	–	NONE
		0.02	0.8	0.95	LSKHS001	2.8×10^{-7}	EVAPORATION
				0.05	LSKHS002	1.5×10^{-8}	WATER ONLY
			0.2	0.95	LSKHC003	7.0×10^{-8}	BURN
				0.05	LSKHC004	3.7×10^{-9}	BURN

Fig. 8-13. Event tree for marine vessel collision initiating event

The accident sequences resulting from the analysis are listed in Table 8-45.

Three types of analyses, interaction, penetration, and traffic, were performed to provide input into the computer model for the offsite portion of the risk analysis.

For the interaction analysis, the specific vessel information is examined as well as information on the channel configuration, geometry, water depths, and the proximity of fixed or floating obstacles within each of the subdivisions called port elements. An example of how this is used is the case for grounding. Over one port element, a specific accident frequency exists from the data base from a specific vessel size such as a LASH vessel or lighter. This accident frequency will depend on many things, such as, the configuration of the channel and the water depth. In shallow waters, the accident frequency will obviously be higher. For deep, wide channels, the incidences of groundings is zero. As a result, the accident frequency will vary from port element to port element, and the total accident rate is therefore the aggregated probability of occurrence of a grounding accident over the entire string of port elements. Similarly, this is done for collisions and rammings.

Given the occurrence of a collision, grounding, or ramming accident, the model then examines the data base to determine the severity of the resulting damage. This is referred to as the penetration analysis. The penetration analysis provides the conditional probability of the extent of structural damage or penetration necessary to reach the packages containing the chemical munitions agent and thus, release the agent. The severity of the mechanical forces or the extent of penetration is a function of the energy transfer between the colliding bodies (i.e., ship and ship, or ship and obstacle, or ship and sea bottom), which in turn is a function of the size, speed, collision geometry, and structural characteristics of the ship and the other ship (in the case

TABLE 8-45
SUMMARY OF OFFSITE MARINE TRANSPORT SEQUENCES

Initiating Event	Fire	Sink	Barge Inland	LASH Inland	LASH Coastal	LASH Sea
Collision and munition failure	N	N	BI01	LI01	LC01	LS01
	N	Y	BI02	LI02	LC02	LS02
	Y	N	BI03	LI03	LC03	LS03
	Y	Y	BI04	LI04	LC04	LS04
Ramming and munition failure	N	N	BI05	LI05	LC05	LS05
	N	Y	BI06	LI06	LC06	LS06
	Y	N	BI07	LI07	LC07	LS07
	Y	Y	BI08	LI08	LC08	LS08
Grounding and munition failure	N	N	BI09	LI09	LC09	LS09
	N	Y	BI10	LI10	LC10	LS10
	Y	N	BI11	LI11	LC11	LS11
	Y	Y	BI12	LI12	LC12	LS12
Heavy weather and munition failure	N	N	BI13	LI13	LC13	LS13
	N	Y	BI14	LI14	LC14	LS14
	Y	N	BI15	LI15	LC15	LS15
	Y	Y	BI16	LI16	LC16	LS16
On-board fire and munition failure	--	N	BI17	LI17	LC17	LS17
	--	Y	BI18	LI18	LC18	LS18
Collision[a]	N	Y	BI19	LI19	LC19	LS19
Ramming[a]	N	Y	BI20	LI20	LC20	LS20
Grounding[a]	N	Y	BI21	LI21	LC21	LS21
Heavy weather[a]	N	Y	BI22	LI22	LC22	LS22
Aircraft crash	Y	N	BI23	LI23	LC23	LS23

[a]No immediate munition failure in these sequences.

of collisions) or the fixed or floating obstacle (in the case of rammings) or the contour and constituency of the bottom (in the case of groundings).

The last type of analysis performed, the traffic analysis, provides the number and size distribution vessel encountered and the geometric orientation of those encounters relative to the LASH ship or lighter and the port elements in which those encounters are likely to occur over the transit. These are all derived from historic traffic data of the port, environmental factors, and the port geometry.

The computer model begins by searching both the accident data file and the traffic file for the overall area under consideration (i.e., the Chesapeake Bay from the anchorage in the vicinity of the Bush River to the Virginia Capes) and for ships of similar size and similar characteristics. It then calculates the basic event frequency. In this example it is the historic collision accident rate (i.e., collision event per transit).

Within each port element, the model also estimates a percentage decrease in accident rate for any controlled parameters within the system. In the illustrated case, the effect of two controlled parameters are integrated: namely, the Coast Guard escort and the tug boats. The percentage decreases in the expected accident rate for both parameters are functions of the port element channel width, depth, and geometry and port traffic (in terms of both vessel encounters and the historic traffic size distribution). In the case of the tug boat parameter, there is an additional independent variable and that is the two different modes of tug boat utilization in different port elements; i.e., providing direct, positive assistance (tied on) or trailing astern to provide assistance in the event of a propulsion or steering failure (in attendance). As can be seen from the flow diagram, the value which results is the estimated frequency of any collision accident in the port element under consideration. The estimated frequency of the collision accident is then subdivided into those with "No Release" and those with a

"Release" using the historic accident data file. The data base makes this differentiation according to whether the involved ship's hull was ruptured as a result of the accident.

As the example shows, within each of these two major divisions of accidents, No Release and Release, the model further breaks down these two categories:

1. The vessel not sinking and no subsequent fire occurring.
2. The vessel sinking and no subsequent fire occurring.
3. The vessel not sinking and a subsequent fire occurring.
4. The vessel both sinking and having a subsequent fire occur.

In each branch, the model determines a series of conditional probabilities associated with the estimated probability for the collision event (with or without a release, as the case may be) in order to determine the estimated probabilities for the four combinations of with and without sinking and with and without a subsequent fire occurring. As an example, the branch for the probability of a release from a collision with sinking only no subsequent fire occurring, begins with a determination of the conditional probability of the LASH ship being the struck vessel in the accident. It then determines the conditional probability of the length of damage being greater than (>) some value "X". X is an input which is related to the ship's inherent survivability characteristics and is the length necessary to flood sufficient compartments along the ship to cause the ship to sink for any extent of transverse penetration. Based on both historical data and the LASH ship's loading arrangement in all three dimensions, the model next determines the conditional probability of the damage being within the cargo area, as opposed to the engine room and other noncargo hold areas. From historical data, it then determines the conditional probability of the transverse penetration being greater than (>) some value "Y". In the case of the LASH ship as loaded with the ton containers within the steel packages within the lighters, Y is the transverse distance from the outboard

side of the ship's shell plating to the first line of packages within the lighters or a distance in excess of 32 ft.

The conditional probability of transverse penetration comes from historical data and is dependent upon three factors. The first one is the striking ship's size or mass which in turn is a function of the port's traffic size distribution. The second is the striking ship's speed which in turn is a function of the port's traffic characteristics and the port element under consideration and in particular, the port element's channel depth, width, and geometry, all of which affect the speed of ships within that channel. The third and last factor is the angle of incidence between the striking ship and the struck LASH ship which in turn is a function of the channel's geometry, such as turns or intersecting channels.

The model next determines the conditional probability of no ignition which is 1 minus the conditional probability of ignition for collisions. The conditional probability of ignition for collisions is determined from historical data and the flammability characteristics of the chemical munitions agent relative to the products ignited by collisions within the accident data base.

The last portion of this branch determines the conditional probability of the water depth within four ship lengths of either side of the channel(s) in the port element being greater than (>) some value D and thus, the conditional probability of the vessel sinking to some depth, D. In this instance, D was input as 60 ft or the depth necessary to bring the water to the edge of the main deck.

The computer results are expressed as the accident frequency per trip. A limiting number of 3.0×10^{-9} is included in the computer model so that values less than this are truncated and only the truncated value is reported. The results of the computer output are given in Tables 8-46 and 8-47. Table 8-46 is the frequency of a lighter accident which will cause a release (R). The failure mode for each of these

TABLE 8-46
FREQUENCY OF AGENT RELEASE FOR THE LIGHTER
IN THE CHESAPEAKE BAY (BUSH RIVER TO VIRGINIA CAPES)

Scenario Elements	Collision Frequency Per Trip	Grounding Frequency Per Trip	Ramming Frequency Per Trip	Structural Frequency Per Trip	Total Frequency Per Trip
R/NS/NF	(a)	(a)	(a)	(a)	0
R/S/NF	3.1×10^{-6}	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	3.1×10^{-6}
R/NS/F	(a)	(a)	(a)	(a)	0
R/S/F	2.0×10^{-6}	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	2.0×10^{-6}
R/ALL	5.1×10^{-6}	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	5.1×10^{-6}

[a] For lighters, release (R) and no sinking (NS) are mutually exclusive. Fires (F) and no fires (NF) are also mutually exclusive.

TABLE 8-47
FREQUENCY OF AGENT RELEASE FOR THE SHIP IN THE CHESAPEAKE BAY
(BUSH RIVER TO VIRGINIA CAPES)

Scenario Elements	Collision Frequency Per Trip	Grounding Frequency Per Trip	Ramming Frequency Per Trip	Fire Frequency Per Trip	Structural Frequency Per Trip	Total Frequency Per Trip
R/NS/NF	2.7×10^{-6}	1.7×10^{-6}	1.2×10^{-7}	(a)	$<3.0 \times 10^{-9}$	4.6×10^{-6}
R/S/NF	1.4×10^{-7}	1.4×10^{-7}	$<3.0 \times 10^{-9}$	(a)	$<3.0 \times 10^{-9}$	2.8×10^{-7}
R/NS/F	6.7×10^{-7}	3.6×10^{-8}	3.0×10^{-8}	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	7.3×10^{-7}
R/S/F	3.5×10^{-8}	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	3.5×10^{-8}
R/ALL	3.5×10^{-6}	1.9×10^{-6}	1.5×10^{-7}	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	5.6×10^{-6}

(a)Fire (F), as the accident event, and no fire (NF) are mutually exclusive. S and NS denote sinking and no sinking; R denotes agent release.

agent releases are crush, but the probabilities of releases with sinking (S) and without sinking (NS) and for fire (F) and without fire (NF) have also been calculated because the consequences may vary as a result of these additional conditions. As shown in Table 8-46 for lighters, a release and no sinking are mutually exclusive, since a severe enough accident to cause a release will also sink the lighter. The probability for grounding, rammings, and structural damage are truncated at the 3.0×10^{-9} value.

Tables 8-47 through 8-49 contain the frequency of a LASH ship accident which will cause a release. These are evaluated for the bay area, the coastal area, and the high seas, respectively. Fire has been added as an initiating event, since unlike the lighter, the ship can contain an ignition source.

The last table of the computer model output, Table 8-50, is the frequency of a ship accident, but one which is not severe enough to cause an immediate release. These accidents are reported since sinking the LASH ship on the high seas may result in a rupture of the ton containers at ocean depths and allows the consequences of such an accident to be evaluated.

In addition to the accidents which were specifically model by the computer, it was requested that the scenario of an aircraft crashing into a lighter or a LASH vessel be developed. An earlier study (Ref. 8-26) for LNG ships in the Chesapeake Bay area has estimated this frequency of occurrences a 2.7×10^{-9} accidents per ship transit. This number is based on all type aircraft for a ship in transit, and is used for the accident frequency for the LASH vessel in transit.

The aircraft crash frequencies specifically for APG are presented in Section 4.2. These are given in accidents per square mile per year. This value was used as the basis for the frequency of occurrence for the lighters. For aircraft crashes into the lighter which will be loaded

TABLE 8-48
FREQUENCY OF AGENT RELEASE FOR THE SHIP IN THE COASTAL AREAS

Scenario Elements	Collision Frequency Per Trip	Grounding Frequency Per Trip	Ramming Frequency Per Trip	Fire Frequency Per Trip	Structural Frequency Per Trip	Total Frequency Per Trip
R/NS/NF	1.2×10^{-6}	5.1×10^{-7}	8.0×10^{-8}	(a)	$<3.0 \times 10^{-9}$	1.8×10^{-6}
R/S/NF	6.5×10^{-8}	4.2×10^{-8}	$<3.0 \times 10^{-9}$	(a)	$<3.0 \times 10^{-9}$	1.1×10^{-7}
R/NS/F	3.1×10^{-7}	1.0×10^{-8}	2.0×10^{-8}	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	3.4×10^{-7}
R/S/F	1.6×10^{-8}	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	1.6×10^{-8}
R/ALL	1.6×10^{-6}	5.6×10^{-7}	10.0×10^{-8}	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	2.3×10^{-6}

(a) Fire (F), as the accident event, and no fire (NF) are mutually exclusive. S and NS denote sinking and no sinking; R denotes agent release.

TABLE 8-49
FREQUENCY OF AGENT RELEASE FOR THE SHIP ON THE HIGH SEAS

Scenario Elements	Collision Frequency Per Trip	Grounding Frequency Per Trip	Ramming Frequency Per Trip	Fire Frequency Per Trip	Structural Frequency Per Trip	Total Frequency Per Trip
R/NS/NF	2.8×10^{-7}	4.3×10^{-8}	6.2×10^{-8}	(a)	$<3.0 \times 10^{-9}$	3.8×10^{-7}
R/S/NF	1.5×10^{-8}	3.5×10^{-9}	$<3.0 \times 10^{-9}$	(a)	$<3.0 \times 10^{-9}$	1.8×10^{-8}
R/NS/F	7.0×10^{-8}	$<3.0 \times 10^{-9}$	1.6×10^{-8}	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	8.5×10^{-8}
R/S/F	3.7×10^{-9}	$<3.0 \times 10^{-9}$	$<3.0 \times 10$ [illegible]	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	3.7×10^{-9}
R/ALL	3.7×10^{-7}	4.7×10^{-8}	7.8×10^{-8}	$<3.0 \times 10^{-9}$	$<3.0 \times 10^{-9}$	4.9×10^{-7}

(a) Fire (F), as the accident event, and no fire (NF) are mutually exclusive. S and NS denote sinking and no sinking; R denotes agent release.

TABLE 8-50

FREQUENCY OF ACCIDENTS WITHOUT A RELEASE FOR THE SHIP ON THE HIGH SEAS

Scenario Elements	Collision Frequency Per Trip	Grounding Frequency Per Trip	Ramming Frequency Per Trip	Fire Frequency Per Trip	Structural Frequency Per Trip	Total Frequency Per Trip
NR/NS/NF	1.8×10^{-5}	5.5×10^{-6}	1.3×10^{-5}	(a)	$<3.0 \times 10^{-9}$	3.7×10^{-5}
NR/S/NF	6.1×10^{-8}	3.9×10^{-8}	$<3.0 \times 10^{-9}$	(a)	$<3.0 \times 10^{-9}$	1.0×10^{-7}
NR/NS/F	(b)	(b)	(b)	(b)	(b)	0.0×10^{0}
NR/S/F	(b)	(b)	(b)	(b)	(b)	0.0×10^{0}
NR/ALL	1.8×10^{-5}	5.6×10^{-6}	1.3×10^{-5}	0.0×10^{0}	$<3.0 \times 10^{-9}$	3.7×10^{-5}

[a] Fire (F), as the accident event, and no fire (NF) are mutually exclusive, as are sinking (S) and no sinking (NS).

[b] An accident severe enough to cause a fire would result in a release, therefore no release (NR) and fire (F) are mutually exclusive.

and stored near the site, the accident frequency is based on the accident rates for a 31.2 x 61.5 ft lighter with a maximum of ten lighters in the loading area. The probability is 2.1 x 10^{-7} accidents per year. This is lower than that for open storage, as expected, since there is less square mileage. This number is also used for the lighters in transit from the storage area to the LASH vessel since they will be towed in flotillas of 10 and because of the close proximity of the ship to the storage area.

The results have been formatted in the accident sequence identification format and are presented in Table 8-51. The collision accident frequencies are the first four accident scenarios. The first collision sequence is for the no sinking and no fire situation for the lighter and the three separate ship transport areas. The second collision sequence is for the sinking and no fire situation for the lighter and for the three separate ship transport areas and likewise down the list for rammings, groundings, fire, and structural damage.

TABLE 8-51
FREQUENCIES OF OFFSITE MARINE TRANSPORT ACCIDENT SEQUENCES

Sequence I.D.	Sequence Description	Frequency Per Trip
BIKHS001 -	A collision occurs and crush forces	N/A
LIKHS001	fail agent containment.	2.7×10^{-6}
LCKHS001		1.2×10^{-6}
LSKHS001		2.8×10^{-7}
BIKHS002 -	A collision occurs and crush forces	3.1×10^{-6}
LIKHS002	fail agent containment. Sinking	1.4×10^{-7}
LCKHS002	also occurs.	6.5×10^{-8}
LSKHS002		
BIKHC003 -	A collision occurs and crush forces	N/A
LIKHC003	fail agent containment. A fire breaks	6.7×10^{-7}
LCKHC003	out.	3.1×10^{-7}
LSKHC003		7.0×10^{-8}
BIKHC004 -	A collision occurs and crush forces	2.0×10^{-6}
LIKHC004	fail agent containment. A fire breaks	3.5×10^{-8}
LCKHC004	out and sinking occurs.	1.6×10^{-8}
LSKHC004		3.7×10^{-9}
BIKHS005 -	A ramming occurs and crush forces fail	N/A
LIKHS005	agent containment.	1.2×10^{-7}
LCKHS005		8.0×10^{-8}
LSKHS005		3.7×10^{-9}
BIKHS006 -	A ramming occurs and crush forces fail	$<3.0 \times 10^{-9}$
LIKHS006	agent containment. Sinking also occurs.	$<3.0 \times 10^{-9}$
LCKHS006		$<3.0 \times 10^{-9}$
LSKHS006		$<3.0 \times 10^{-9}$
BIKHC007 -	A ramming accident occurs and crush	N/A
LIKHC007	forces fail agent containment. A fire	3.0×10^{-8}
LCKHC007	breaks out.	2.0×10^{-8}
LSKHC007		1.6×10^{-8}
BIKHC008 -	A ramming accident occurs and crush	$<3.0 \times 10^{-9}$
LIKHC008	forces fail agent containment. A fire	$<3.0 \times 10^{-9}$
LCKHC008	breaks out and sinking occurs.	$<3.0 \times 10^{-9}$
LSKHC008		$<3.0 \times 10^{-9}$
BIKHS009 -	A grounding accident occurs and crush	N/A
LIKHS009	forces fail agent containment.	1.8×10^{-6}
LCKHS009		5.1×10^{-7}
LSKHS009		4.3×10^{-8}

TABLE 8-51 (Continued)

Sequence I.D.	Sequence Description	Frequency Per Trip
BIKHS010 - LIKHS010 LCKHS010 LSKHS010	A grounding accident occurs and crush forces fail agent containment. Sinking also occurs.	$<3.0 \times 10^{-9}$ 1.4×10^{-7} 4.2×10^{-8} 3.5×10^{-9}
BIKHC011 - LIKHC011 LCKHC011 LSKHC011	A grounding accident occurs and crush forces fail agent containment. A fire breaks out.	N/A 3.6×10^{-8} 1.0×10^{-8} $<3.0 \times 10^{-9}$
BIKHC012 - LIKHC012 LCKHC012 LSKHC012	A grounding accident occurs and crush forces fail agent containment. A fire breaks out and sinking occurs.	$<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$
BIKHS013 - LIKHS013 LCKHS013 LSKHS013	Structural damage due to heavy weather occurs. Crush forces fail agent containment.	N/A $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$
BIKHS014 - LIKHS014 LCKHS014 LSKHS014	Structural damage due to heavy weather occurs. Crush forces fail agent containment. Sinking also occurs.	$<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$
BIKHC015 - LIKHC015 LCKHC015 LSKHC015	Structural damage due to heavy weather occurs. Crush forces fail agent containment. A fire breaks out.	N/A $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$
BIKHC016 - LIKHC016 LCKHC016 LSKHC016	Structural damage due to heavy weather occurs. Crush forces fail agent containment. A fire breaks out and sinking occurs.	$<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$
BIKHF017 - LIKHF017 LCKHF017 LSKHF017	Spontaneous fire occurs.	N/A $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$
BIKHC018 - LIKHC018 LCKHC018 LSKHC018	Spontaneous fire occurs. Sinking also occurs.	N/A $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$ $<3.0 \times 10^{-9}$

TABLE 8-51 (Continued)

Sequence I.D.	Sequence Description	Frequency Per Trip
BIKHS019 -	Collision accident occurs with no	3.5×10^{-6}
LIKHS019	immediate release. Sinking also	5.8×10^{-7}
LCKHS019	occurs.	2.7×10^{-7}
LSKHS019		6.1×10^{-8}
BIKHS020 -	Ramming accident occurs with no	3.3×10^{-6}
LIKHS020	immediate release. Sinking also	$<3.0 \times 10^{-9}$
LCKHS020	occurs.	$<3.0 \times 10^{-9}$
LSKHS020		3.9×10^{-8}
BIKHS021 -	Grounding accident occurs with no	1.6×10^{-6}
LIKHS021	immediate release. Sinking also	1.6×10^{-6}
LCKHS021	occurs.	4.7×10^{-7}
LSKHS021		$<3.0 \times 10^{-9}$
BIKHS022 -	Structural damage due to heavy weather	$<3.0 \times 10^{-9}$
LIKHS022	occurs with no immediate release.	$<3.0 \times 10^{-9}$
LCKHS022	Sinking also occurs.	$<3.0 \times 10^{-9}$
LSKHS022		$<3.0 \times 10^{-9}$
BIKHS023 -	Aircraft crashes into marine vessel.	2.1×10^{-7}
LIKHS023		2.7×10^{-9}
LCKHS023		2.7×10^{-9}
LSKHS023		2.7×10^{-9}

8.5. UNCERTAINTY ANALYSIS

The results of the uncertainty analysis indicate that the 95th percentile values may be up to: (1) 160 times higher than the median values for the truck transport scenarios, (2) 120 times higher than the median values for the rail transport scenarios, and (3) 600 times higher than the median values for the air transport scenarios. For the marine accident scenarios, the 95th percentile values are 10 times higher than the median values.

Tables 8-52 through 8-56 present the error factors used. Where sufficient statistical data exist to establish the 95th percentile values, they are reflected in the smaller error factors assigned to those events which usually range from 3 to 5. Otherwise, the error factors were based on engineering judgment. The guidelines for assigning error factors presented in Section 5.5 were also applied here.

Sequence frequencies for marine transport are presented in Table 8-51. The range factor assigned to final frequency results is 10 for all sequences.

TABLE 8-52
UNCERTAINTY DATA FOR ONSITE TRUCK TRANSPORTATION
(IN ONSITE PACKAGE) ACCIDENT SEQUENCES

Event No.	Name	Probability	Range Factor
BE31	Truck collision/overturn	1.4×10^{-7}	20
BE68	Crush force generated	1	--
BE73	Crush force agent containment (crush >50,000 lb)	0.1	2
BE60	Impact force generated	1	--
BE71	Impact force fails containment	ϵ	--
BE64	Probe generated	1.6×10^{-2}	3
BE67	Probe fails agent containment (V/R >100/s)	2.4×10^{-2}	2
BE62	Fire generated	1.7×10^{-1}	2
BE63	Fire has heat and duration to detonate burster (>50 min)	1×10^{-6}	50
BE31A	Truck collision/overturn Same as BE31		
BE61(R)	Impact force sufficient to detonate rocket	2×10^{-3}	5
BE52′	Mechanical forces destroy ONC	1×10^{-2}	3
BE62A	Fire occurs given truck collision/overturn	7×10^{-2}	2
BE61	Undue force sufficient to detonate burster	2.2×10^{-5}	25
BE75	Thermal force fails agent containment (>15 min)	1×10^{-6}	50
BE31 (Aircraft)	Aircraft crash occurs at:		
	APG	1.3×10^{-7}	10
	ANAD	1.1×10^{-9}	10
	LBAD	5×10^{-10}	10

TABLE 8-52 (Continued)

Event No.	Name	Probability	Range Factor
	NAAP	9.1×10^{-9}	10
	PBA	2×10^{-9}	10
	PUDA	8.4×10^{-9}	10
	TEAD	2.8×10^{-10}	10
	UMDA	1.8×10^{-9}	10
BE60	Impact force only (no fire)	5.5×10^{-1}	--
BE71	Impact force fails containment	1	--
BE60/62	Impact and fire generated	4.5×10^{-1}	--
BE31 (EQ)	Earthquake occurs (>0.5 g):		
	TEAD	1×10^{-4}	10
	NAAP	2×10^{-5}	10
	Elsewhere	6×10^{-6}	10
BE68	Crush force generated	1	--
BE62 (EQ)	Fire generated (Same as BE62A)		
BE31 (Tornado)	Tornado occurs (winds >160 mph):		
	TEAD, UMDA	3.3×10^{-7}	10
	PUDA, APG	5.6×10^{-6}	10
	Elsewhere	1×10^{-4}	10
BE31′	Trucks caught in bad weather	0.1	2
BE64	Tornado-generated missile capable of failing containment (>250 mph):		
	TEAD, UMDA	5.4×10^{-3}	10
	PUDA, APG	1.8×10^{-2}	10
	Elsewhere	1.4×10^{-2}	10
BE51	Missile fails containment	5.3×10^{-5}	50
BE64A	Probe generated	1.6×10^{-2}	3

TABLE 8-53
UNCERTAINTY DATA FOR ONSITE TRUCK TRANSPORTATION
(OFFSITE PACKAGE) ACCIDENT SEQUENCES

Event No.	Name	Probability	Range Factor
BE31	Truck collision/overturn	1.4×10^{-7}	20
BE68	Crush force generated	5×10^{-2}	2
BE73	Crush force fails containment	ϵ	--
BE60	Impact force generated	8×10^{-1}	1.4
BE71	Impact force fails containment	ϵ	--
BE64	Puncture environment occurs	2×10^{-1}	2
BE67	Probe fails agent containment (0.75-in. mild steel wall equivalent thickness)	1×10^{-2}	2
BE31 for scenario VR4	Truck accident occurs	1.7×10^{-7}	20
BE62	Fire generated	1.7×10^{-1}	2
BE63	Fire has heat and duration	ϵ	--
BE31A	Truck collision/overturn	1.4×10^{-7}	20
BE52′	Mechanical forces destroy package	1×10^{-2}	3
BE62A	Fire occurs given collision or overturn	7×10^{-2}	20
BE63A	Fire has heat and detonation	ϵ	--
BE61 (R)	Impact force sufficient to detonate burster	2×10^{-3}	5
BE61	Undue force detonation occurs	2.2×10^{-5}	25
BE75A	Thermal force fails agent containment	ϵ	--

TABLE 8-53 (Continued)

Event No.	Name	Probability	Range Factor
BE31 (Aircraft)	Aircraft crash occurs at:		
	APG	1.3×10^{-7}	10
	ANAD	1.1×10^{-9}	10
	LBAD	5×10^{-10}	10
	NAAP	9.1×10^{-9}	10
	PBA	2×10^{-9}	10
	PUDA	8.4×10^{-9}	10
	TEAD	2.8×10^{-10}	10
	UMDA	1.8×10^{-9}	10
BE60	Impact force only (no fire)	5.5×10^{-1}	--
BE71	Impact force fails containment	1	--
BE60/62	Impact and fire generated	4.5×10^{-1}	--
BE31 (EQ)	Earthquake occurs (>0.5 g):		
	TEAD	1×10^{-4}	10
	NAAP	2×10^{-5}	10
	Elsewhere	6×10^{-6}	10
BE68	Crush force generated	5×10^{-2}	2
BE73	Crush force fails containment	ϵ	--
BE62 (EQ)	Fire generated (Same as BE62A)		
BE31 (Tornado)	Tornado occurs (winds >160 mph):		
	TEAD, UMDA	3.3×10^{-7}	10
	PUDA, APG	5.6×10^{-6}	10
	Elsewhere	1×10^{-4}	10
BE31′	Trucks caught in bad weather	0.1	2

TABLE 8-53 (Continued)

Event No.	Name	Probability	Range Factor
BE64	Tornado-generated missile capable of failing containment (>310 mph):		
	TEAD, UMDA	1.7×10^{-4}	10
	PUDA, APG	1.1×10^{-3}	10
	Elsewhere	1.4×10^{-3}	10
BE51	Missile fails containment	3×10^{-5}	50
BE64A	Probe generated	2×10^{-1}	3
BE51A	Probe fails containment	1×10^{-2}	2

TABLE 8-54
UNCERTAINTY DATA FOR OFFSITE RAIL ACCIDENT
TRANSPORTATION SEQUENCES

Event No.	Name	Probability	Range Factor
BE33	Train accident occurs	5.5×10^{-6}	20
BE68	Crush force generated	2×10^{-3}	2
BE53	Crush force fails containment	ϵ	--
BE60	Impact force generated	1	--
BE52	Impact force fails package	3×10^{-3}	3
BE61	Impact force fails munition	ϵ	--
BE64	Probe generated	5.9×10^{-4}	5
BE51	Probe fails package	1	--
BE62	Fire generated	3.9×10^{-4}	20
BE63	Fire has heat and duration to detonate burster	1.6×10^{-1}	2
BE52′	Mechanical forces destroy package	1×10^{-2}	3
BE63A	Fire has heat and duration to detonate burstered munitions in package (>30 min):		
	C (49 min)	5.5×10^{-1}	1.5
	P (89 min)	3×10^{-1}	2
	M (68 min)	4×10^{-1}	1.5
	R (10.5 min)	7.5×10^{-1}	1.4
BE53	Undue force detonates burster	1.6×10^{-5}	25
BE75A	Fire has heat and duration to fail nonburstered munition	1.6×10^{-1}	2
BE33 (Aircraft)	Aircraft crash occurs	3.1×10^{-11}	20
BE60	Impact-only force generated	5.5×10^{-1}	--
BE52	Impact force fails package	1	--

TABLE 8-54 (Continued)

Event No.	Name	Probability	Range Factor
BE61	Impact force fails munition	1	--
BE60/62	Impact and fire generated	4.5×10^{-1}	--
BE33 (EQ)	Earthquake occurs (0.35 g):		
	UMDA to TEAD	8.2×10^{-4}	25
	PUDA to TEAD	2.5×10^{-4}	25
	LBAD to TEAD	5.1×10^{-4}	25
	APG to TEAD	1.9×10^{-4}	25
	ANAD to TEAD	2.4×10^{-4}	25
	NAAP to TEAD	2.2×10^{-4}	25
	PBA to TEAD	2.7×10^{-4}	25
	LBAD to ANAD	2.8×10^{-4}	25
	PBA to ANAD	5.3×10^{-4}	25
	APG to ANAD	2×10^{-4}	25
	NAAP to ANAD	3×10^{-4}	25
BE68	Crush force generated	2×10^{-3}	2
BE33 (Tornado)	Tornado occurs (winds >160 mph):		
	UMDA to TEAD	3.3×10^{-7}	25
	PUDA to TEAD	3.7×10^{-7}	25
	LBAD to TEAD	7.3×10^{-5}	25
	APG to TEAD	6.8×10^{-5}	25
	ANAD to TEAD	7.6×10^{-5}	25
	NAAP to TEAD	6.6×10^{-5}	25
	PBA to TEAD	7.3×10^{-5}	25
	LBAD to ANAD	1×10^{-4}	25
	PBA to ANAD	1×10^{-4}	25
	APG to ANAD	9.3×10^{-5}	25
	NAAP to ANAD	1×10^{-4}	25

TABLE 8-54 (Continued)

Event No.	Name	Probability	Range Factor
BE64	Missile capable of puncturing and failing containment generated:		
	UMDA to TEAD	1.7×10^{-4}	25
	PUDA to TEAD	3×10^{-3}	25
	LBAD to TEAD	1.4×10^{-3}	25
	APG to TEAD	1.4×10^{-3}	25
	ANAD to TEAD	1.4×10^{-3}	25
	NAAP to TEAD	1.4×10^{-3}	25
	PBA to TEAD	1.4×10^{-3}	25
	LBAD to ANAD	1.4×10^{-3}	25
	PBA to ANAD	1.4×10^{-3}	25
	APG to ANAD	1.4×10^{-3}	25
	NAAP to ANAD	1.4×10^{-3}	25
BE51	Missile has orientation to fail containment	5.3×10^{-5}	50
BE68	Crush force generated	2×10^{-3}	2

TABLE 8-55
UNCERTAINTY DATA FOR OFFSITE TRANSPORTATION BY AIR ACCIDENT SEQUENCES

Event No.	Name	Probability	Range Factor
A1	Accident rate/flight	See Section 8.3.3.1.5	10
A2	Impact only force generated	2.7×10^{-1}	2
A3	Impact force fails package:		
	Takeoff	1.5×10^{-1}	1.5
	Inflight	7×10^{-1}	1.5
	Landing	1.3×10^{-1}	1.5
A4	Impact and fire occur	2.2×10^{-1}	2
A5	Fire is only force present	1.3×10^{-1}	2
A6	Fire fails package (C-141)	ϵ	--
A7	Fire fails package (C-5)	9×10^{-2}	2
A7′	Undue force detonation	2.1×10^{-3}	25
A8	Impact causes rocket motor ignition	4.4×10^{-2}	5
A9	Impact greater than 40 ft:		
	Takeoff	3.1×10^{-1}	1.5
	Inflight	3×10^{-1}	1.5
	Landing	3.3×10^{-1}	1.5

TABLE 8-56
UNCERTAINTY DATA FOR ONSITE TRUCK TRANSPORTATION
ACCIDENT SEQUENCES (MARINE OPTION)

Event No.	Name	Probability	Range Factor
BE31	Truck collision/overturn	1.4×10^{-7}	20
BE68	Crush force generated	1	--
BE73	Crush force fails agent containment	ϵ	--
BE60	Impact force generated	1	--
BE71	Impact force fails containment	ϵ	--
BE64	Probe generated	1.6×10^{-2}	3
BE67	Probe fails agent containment (V/R >100/s)	1.2×10^{-2}	2
BE62	Fire generated	1.7×10^{-1}	2
BE31A	Truck collision/overturn Same as BE31		
BE52′	Mechanical forces destroy vault	1×10^{-2}	3
BE62A	Fire occurs given truck collision/overturn	7×10^{-2}	2
BE75	Thermal force fails agent containment	ϵ	--
BE31 (Aircraft)	Aircraft crash occurs at:		
	APG	1.3×10^{-7}	10
BE60	Impact force only (no fire)	5.5×10^{-1}	--
BE71	Impact force fails containment	1	--
BE60/62	Impact and fire generated	4.5×10^{-1}	--
BE31 (EQ)	Earthquake occurs (>0.5 g):		
	APG	6×10^{-6}	10
BE68	Crush force generated	1	--

TABLE 8-56 (Continued)

Event No.	Name	Probability	Range Factor
BE62 (EQ)	Fire generated (Same as BE62A)		
BE31 (Tornado)	Tornado occurs (winds >160 mph):		
	APG	5.6×10^{-6}	10
BE31'	Trucks caught in bad weather	0.1	2
BE64	Tornado-generated missile capable of failing containment (>250 mph):		
	APG	1.1×10^{-3}	10
BE51	Missile fails containment	1.7×10^{-5}	50

8.6. REFERENCES

8-1. Clarke, R. K., et al., "Severities of Transportation Accidents," SCA-74-0001, Sandia National Laboratories, July 1976.

8-2. Dennis, A. W., et al., "Severities of Transportation Accidents Involving Large Packages," SAND77-0001, Sandia National Laboratories, May 1978.

8-3. Fischer, L. E., et al.. "Shipping Container Response to Severe Highway and Railway Accident Conditions," NUREG/CR-4829, Vols. 1 and 2, Lawrence Livermore National Laboratory, February 1987.

8-4. Letter, W. R. Rhyne to R. Bolig, dated April 9, 1987, "Comparison of Recent Truck/Rail Accident Data with the Data Used in the Transport Risk Analysis."

8-5. Rhyne, W. R., et al., "Probabilistic Analysis of Chemical Agent Release During Transport of M55 Rockets," H&R Technical Associates, Inc., M55-CD-4, H&R 255-1, September 1985.

8-6. "Supporting Calculations for the Risk Analysis of the Disposal of Chemical Munitions at National or Regional Sites," GA Technologies Inc., EPS-GA/DP-0092 (Issue 2), August 1987.

8-7. Finnegan, R. L., et al., "Preliminary Impact Speed and Angle Criteria for Design of a Nuclear Airplane Fission Product Containment Vessel," TMX-2245, National Aeronautics and Space Administration, May 1971.

8-8. "Transportation of Chemical Agents and Munitions: A Concept Plan," U.S. Army Office of the Program Manager for Chemical Munitions, The MITRE Corporation, Report MTR-87W00075, June 30, 1987.

8-9. Fraize, W., et al., "Preliminary Risk Analysis Supporting the Chemical Weapons Stockpile Disposal Program (CSDP)," The MITRE Corporation, Volume 1: Analysis, MTR-86W4-01 and Volume 2: Appendices, MTR-86W4-02, May 1987.

8-10. "Chemical Stockpile Disposal Concept Plan," USATHAMA, AMXTH-CD-FR-95047, March 1986.

8-11. PMCM meeting at Edgewood Area, October 1986.

8-12. Marone, V. P., Chief, Reports Branch, Directorate of Aerospace Safety, Norton Air Force Base, Letter to R. J. Robinette, H&R Technical Associates, Inc., May 18, 1987.

8-13. Hartman, W. F., Sandia National Laboratories, Albuquerque, New Mexico, Personal communication with W. R. Rhyne, July 1985.

8-14. Federal Railroad Administration, "Accident/Incident Bulletin No. 151, Calendar Year 1982," Department of Transportation, June 1983.

8-15. Letter from E. Hillsman, ORNL to W. R. Rhyne, H&R Technical Associates, Inc., April 15, 1987.

8-16. "Transportation of Chemical Agent and Munitions: A Concept Plan," U.S. Army Program Manager for Chemical Munitions, Aberdeen Proving Ground, Maryland, May 1, 1987.

8-17. Letter from W. R. Rhyne, H&R Technical Associates, Inc. to Dr. R. Bolig, GA Technologies, Inc., May 5, 1987.

8-18. Read, A., et al., "Analysis of Existing Hazardous Material Containers for Transporting Chemical Munitions," The MITRE Corporation, June 1987.

8-19. Letter from W. R. Rhyne to H&R Staff, "Administrative Controls - Rail and Air," File No. 307, April 27, 1987.

8-20. "115 mm Rocket Sensitivity Tests," AEO Project T-222 Chemical Demil Project No. 200, Ammunition Equipment Office, Tooele Army Depot, Tooele, Utah, April 1974.

8-21. "Probabilistic Analysis of Chemical Agent Release During Transport of Obsolete Munitions With and Without Additional Protective Packaging," H&R Technical Associates, Inc., H&R 244-4, June 1986.

8-22. Captain Rich, Flight Safety Branch, U.S. Air Force Inspection and Test Center, Norton AFB, California, personal communication with R. J. Robinette, May 1987.

8-23. "Thermal Response of M55 Rockets to Pool Fires During Transit," Southwest Research Institute for H&R Technical Associates, Inc., SWRI 8461/005, April 1985.

8-24. "FAA Statistical Handbook of Aviation, Calendar Year 1984," U.S. Department of Transportation, Federal Aviation Administration.

8-25. "Risk Analysis for Barge Transportation of Ton Containers from Aberdeen Proving Ground," Engineering Computer Optecnomics, Incorporated, May 13, 1987.

8-26. "Risk Assessment Study for the Cove Point, Maryland LNG Facility," SAI-78-626-LJ, Science Applications, Incorporated, March 23, 1978.

9. QUANTIFICATION BASES

9.1. DATA BASE

9.1.1. Train Accident Data

The train accident rate selected for the transportation risk analysis is from the Sandia National Laboratory (SNL) data base, based on 1972 civilian freight train data. Because the transportation of chemical munitions is a military action under strict supervision and control, a study was made to determine what, if any, reduction could be taken in the civilian train accident rate. Because of a lack of hard data, scientific judgment was used to estimate a reasonable reduction factor due to special administrative controls described in the Transportation Concept Plan (Ref. 9-1).

These administrative controls include the following actions. A pilot train will precede the munition train to ensure track integrity and to provide timely emergency response. Empty railcars will be thoroughly inspected prior to loading, and all engines and equipment will be inspected and tested before departure of the munition train. Routine enroute inspections will occur at least every 1,000 miles. A walking guard on each side of each munition car will be provided during all stops.

Some other controls are expected to be implemented also, but no credit was taken for them in reducing the train accident rate. The train speed limit will be 10 mph less than the posted limit for a given track, but never more than 50 mph. The highest quality track available (FRA Class 3 or better) will be used, consistent with the policy of avoiding highly populated areas. A standard train crew, with special

training in chemical munitions, will operate the train. A railroad officer will also be present on the munition train, to act as crew leader and to serve as liaison with the Army.

The train accident rate given by SNL is 1×10^{-5} accidents/mile (Ref. 9-2). Train accidents used to determine this rate are described by "type" of accident only: collision, derailment, and "other" (including grade-crossing collisions), and not by cause. However, data concerning civilian freight train accidents in 1982 is available from the Federal Railroad Administration (FRA) June 1983 report (Ref. 9-3), where results are reported by category (track, roadbed, and structure, mechanical and electrical, human factors, and miscellaneous factors) and by cause within each category for each accident type.

Table 9-1 shows the numbers of accidents by accident type, and the annual totals for the SNL data and the FRA data.

Because the total numbers of derailments, collisions, and "other" type accidents in 1982 do not differ greatly from those in 1972, it can be assumed that the distribution by category and cause is also similar. Therefore, the administrative controls can be applied to the 1982 accident causes data to estimate a total accident rate reduction factor for the SNL train accident rate.

The FRA data categories and the total number of accidents in each category before and after modification due to administrative controls are shown in Table 9-2.

For accidents in the track, roadbed, and structure defect category, there was not enough information to reduce the number of collisions or "other" type accidents, but it is expected that use of a pilot train will substantially reduce the number of munition train derailments. Therefore, a 95% reduction was taken for each derailment accident cause,

TABLE 9-1
COMPARISON OF 1972 AND 1982 ACCIDENT DATA

	Collisions	Derailments	Other	Total Accidents	Total Miles
SNL, 1972[a]	308	3880	465	4653	4.51×10^8
FRA, 1982[b]	572	3383	456	4589	5.73×10^8

[a]Taken from Ref. 9-2.
[b]Taken from Ref. 9-3.

TABLE 9-2
1982 TRAIN ACCIDENT DATA BY CATEGORY

Category	Original Number	Modified Number
Track, roadbed and structure defects	1769	135
Mechanical and electrical failures	796	597
Human error	1284	1284
Miscellaneous	740	517
Total	4589	2534

resulting in a reduction from 1723 to 89 derailments due to track, roadbed, and structure defects. The total number of accidents in this category was reduced from 1769 to 135. This is the most significant reduction afforded by the administrative controls.

Accidents caused by mechanical and electrical failures could occur in the locomotive, the railcar, or in general. No information was available to reduce these accidents by cause. However, the predeparture inspection and routine inspections at 1,000-mile intervals allow a modest reduction, estimated at 25%, in the total number of accidents due to mechanical and electrical failures. Therefore, the original number of 796 accidents becomes 597 accidents.

No credit is taken for any reduction in accidents caused by human error, because a standard train crew will operate the train. The total number of accidents in this category remains 1284.

For accidents caused by miscellaneous factors, the following reductions were taken:

Cause	Reduction %; Number	Rationale
Vandalism	100%; 78 to 0	Surveillance, walking guard
Interference with railroad operation	100%; 16 to 0	Surveillance, walking guard
Overloaded cars	100%; 5 to 0	Special loading procedures; only two packages per railcar.
Object on or fouling track	100%; 30 to 0	Pilot train
Equipment on or fouling track	100%; 11 to 0	Pilot train
Snow, ice, or mud on track	50%; 61 to 31	Pilot train; use of best track

Fire, not due to vandalism	100%; 24 to 0	Already accounted for in fire probability
Hump retarder fails to slow car	100%; 21 to 0	Not applicable

The number of accidents in this category is reduced from 740 to 517.

The total accident reduction is from 4589 to 2534, a factor of 2534/4539 = 0.55. Therefore, this factor (0.55) is applied to the original SNL train accident rate to determine the modified train accident rate.

$$(1 \times 10^{-5})(0.55) = 5.5 \times 10^{-6} \quad .$$

Thus, 5.5×10^{-6} accidents per mile is the rate chosen for use in this risk analysis. For reference purposes, the original 1982 train accident data from Ref. 9-3 are shown on Tables 9-3 through 9-6.

9.1.2. Onsite Truck Accident Data

The truck convoy accident data summarized here was developed by SNL (Ref. 9-2). These data represent the most comprehensive information currently available and they are commonly used for truck transportation risk analyses. Therefore, an explanation of their bases will not be presented here. A 1987 report by the Lawrence Livermore National Laboratory for the Nuclear Regulatory Commission (Ref. 9-28), describing highway accidents involving spent fuel shipping casks, was reviewed; the more recent data was found to be consistent with the SNL data (Ref. 9-2). Therefore, no changes will be made in the data used for this analysis. The SNL analyses considered five accident forces: impact, crush, puncture, fire, and immersion. Only the first four are discussed here because immersion is not considered a threat for onsite transportation.

TABLE 9-3[a]

TRAIN ACCIDENTS CAUSED BY TRACK, ROADBED, AND STRUCTURE DEFECTS

Cause of Accident	Total Accidents	Collision	Derailments	Other	Rail Highway Crossing
Roadbed defects	109	--	108	1	--
Track geometry defects	751	3	746	2	--
Rail and joint bar defects	459	5	451	3	--
Frogs, switches, and track appliances	428	11	408	9	--
Other way and structure	17	--	7	10	--
Signal and communication failures	5	--	3	2	--
Subtotal	1769	19	1723	27	--

[a]Taken from Ref. 9-3.

TABLE 9-4[a]
TRAIN ACCIDENTS CAUSED BY MECHANICAL AND ELECTRICAL FAILURES

Cause of Accident	Total Accidents	Collision	Derailments	Other	Rail Highway Crossing
Locomotive failure					
Brakes	1	--	1	--	--
Body	--	--	--	--	--
Coupler and draft system	--	--	--	--	--
Truck components	6	--	6	--	--
Axles and journal bearings	6	--	6	--	--
Wheels	8	--	8	--	--
Locomotives	55	1	11	42	1
Doors	--	--	--	--	--
General mechanical and electrical failures	4	1	1	2	--
Car failure					
Brakes	113	12	85	16	--
Trailer or container or flatcar	9	1	5	3	--
Body	73	2	65	6	--
Coupler and draft system	79	13	58	8	--
Truck components	160	--	158	2	--
Axles and journal bearings	125	--	122	3	--
Wheels	136	1	132	3	--
Doors	7	1	4	2	--
General mechanical and electrical failures	14	1	9	4	--
Subtotal	796	33	671	91	1

[a]Taken from Ref. 9-3.

TABLE 9-5[a]
TRAIN ACCIDENTS CAUSED BY HUMAN FACTORS

Cause of Accident	Total Accidents	Collision	Derailments	Other	Rail Highway Crossing
Brakes, use of	223	110	68	45	--
Employee, physical conditions	4	4	--	--	--
Flagging, fixed, hand, and radio signals	47	23	17	7	--
Other rules and instructions	349	220	63	66	--
Speed	121	34	59	28	--
Switches, use of	184	46	123	15	--
Miscellaneous	356	40	287	29	--
Subtotal	1284	447	617	190	--

[a]Taken from Ref. 9-3.

TABLE 9-6[a]
TRAIN ACCIDENTS CAUSED BY MISCELLANEOUS FACTORS

Cause of Accident	Total Accidents	Collision	Derailments	Other	Rail Highway Crossing
Collision with highway user at crossing site	174	--	--	--	174
Emergency brake application to avoid accident	0	--	7	--	1
Vandalism	78	7	38	32	1
Interference with railroad operation, not vandals	16	3	6	7	--
Load shifted	30	1	26	3	--
Load fell from car	6	--	2	4	--
Overloaded car	5	--	5	--	--
Improperly loaded car	17	1	16	--	--
Oversized load, misrouted	4	1	--	3	--
Object on or fouling track	38	--	14	23	1
Equipment on or fouling track	11	4	--	7	--
Cargo tiedown improperly applied	4	--	1	3	--
Overload/improper load container/etc.	2	--	2	--	--
Interaction of lateral/vertical forces	129	1	128	--	--
Failure to control car speed with hand brakes	1	--	1	--	--
Snow, ice, or mud on track	61	7	50	4	--
Fire, not due to vandalism	24	--	--	24	--
Hump retarder failed to slow car	21	8	3	10	--
Switch fouled by loading chains, etc.	7	--	5	2	--
Other causes	97	9	65	23	--
Subtotal	740	43	372	148	177

(a)Taken from Ref. 9-3.

The effect of human factors on the truck accident rate is implicit in the SNL data base. If an accident occurred due to human error, it shows up in the data base just as an accident. Therefore, it is not possible to ascertain the human error contribution or to define the human error probabilities involved. No specific human reliability analysis was done for onsite transportation. Several administrative controls will be instituted, however, and these have the effect of reducing the SNL truck accident rate as shown on Table 9-7 and discussed in Section 8.1.

9.1.3. Plant Accident Data

Component failure data that support all of the fault trees and event trees are presented on the following pages; references are also provided. The data used to quantify the fault tree events are also presented on the fault trees. Beta factors are used to quantify failure probabilities for identical redundant components. The beta factors are also shown on the fault trees.

The derivation of the failure rates used in this study was based on extensive review and analysis of data available in the literature. When a sufficient number of estimates (at least 10, but usually many more) was available for a component failure rate, the method described in "Reliability Engineering"* was used to develop a nonparametric distribution of estimates. The 0.5 percentile of this distribution was used as the median of a lognormal distribution of parameter estimates. The 0.95, 0.50, and 0.05 percentiles of the nonparametric distribution were used to develop an error factor for the lognormal distribution.

When less than 10 estimates were available for a particular component, a most applicable estimate was subjectively selected to represent

---

*ARINC Research Corporation, "Reliability Engineering," Prentice-Hall, Inc., 1964, p. 144.

TABLE 9-7
TRUCK ACCIDENT RATE[a]

Munitions Vehicle Accident Type	Highway Accident Rate (Per Mile)	Convoy Accident Rate (Per Mile)
Head-on collision	4.7×10^{-7}	0
Rear-end collision	3.8×10^{-7}	3.8×10^{-8}
Rear-end collision	4.0×10^{-7}	4.0×10^{-8}
Side-on into collision	1.5×10^{-7}	0
Side-on by other collision	2.3×10^{-7}	0
Truck/train collision	1.6×10^{-8}	0
Fixed object collision	4.3×10^{-7}	4.3×10^{-8}
Overturn only	1.7×10^{-7}	1.7×10^{-8}
Subtotal (collision/ overturn events)	2.47×10^{-6}	1.38×10^{-7}
Fire only	2.8×10^{-8}	2.8×10^{-8}
Total	2.5×10^{-6}	1.66×10^{-7}

[a]Probability (collision or overturn/truck accident) =

$$\frac{1.38 \times 10^{-7}}{1.66 \times 10^{-7}} = 0.831 \quad .$$

$$\text{Probability (fire only/truck accident)} = \frac{2.8 \times 10^{-8}}{1.66 \times 10^{-7}} = 0.169 \quad .$$

the median of a lognormal distribution. The error factor was also selected subjectively, but it was verified that the corresponding lognormal distribution was consistent with the other available estimates.

<u>Fan Fails Off</u> - 0.13/yr (EF = 30)

The Corps of Engineers (HND) R/M Data Base (Ref. 9-4) provides failure rates for fans (all failure modes combined) ranging from 0.9 to 9.17 per million hours. NPRD-3 (Ref. 9-5, pages 201-202) provides a range from 2 to 25 failures per million hours for fans operating under selected environmental conditions (data from GF and NS environmental codes only). Review of the failure mode descriptions in the NPRD-3 report, however, reveals that no more than about 51% of all failure events are relevant to the failure mode of interest here. Thus, the failure rate estimates from these two sources range from about 0.5 to 13 failures per million hours.

NPRDS (Ref. 9-6, pages 287-289) reports a total of 48 fan/blower failures in about 4.06 million operating hours. The failure modes described in the NPRDS report were examined to screen those that do not apply to the event of interest. This review indicates that only 23 events can be associated with the failure mode of interest. Thus, the failure rate is about 5.7×10^{-6}/h.

SRS (Ref. 9-7, item code 663°) provides four fan failure rate estimates ranging from 261 to 867 failures per million operating hours. These estimates were reduced by 50% to screen failure modes that do not apply to this event (the 50% reduction is based on both the NPRD-3 and NPRDS failure mode reviews).

All these sources combined provided a total of 21 failure rate estimates. These estimates were used to develop a distribution of fan failure rates, and this distribution was used to develop conservative parameters of a lognormal distribution to be used in this study.

The median and error factor developed from this distribution are 1.5×10^{-5}/h and 30, respectively.

Motor Fails to Run - 0.061/yr (EF = 20)

The Rijnmond study (Ref. 9-8, Table IX.I) suggests a failure rate range from 0.5 to 100 (median = 7, EF = 14) failures per million hours for a motor failing to run.

NPRDS (Ref. 9-6, pages 403-409) reports a total of 48 ac motor failures in about 5.2 million operating hours. The failure modes described in the NPRDS report were examined to screen those that do not apply to the event of interest, and only about 15 failures were judged applicable here. Thus, the NPRDS estimate is 2.9×10^{-6}/operating hour.

NPRD-3 (Ref. 9-5, pages 199-201) provides a range from 0.5 to 250 failures per million operating hours under selected environmental conditions (data from DOR, GB, GF, and NS environmental codes only). Review of the failure mode descriptions in the NPRD-3 report, however, reveals that no more than about 77% of all failure events are relevant to the failure mode of interest. Thus, the failure rate range from this source is from 0.4 to 193 failures per million operating hours.

WASH-1400 (Ref. 9-9, Table III.4-2) suggests a median of 10×10^{-6}/h with an error factor of 3. SRS (Ref. 9-7, item code 56320) provides ten failure rate estimates for electric motors ranging from 2.9 to 158 failures per million operating hours. These estimates were reduced by 54% to screen failure modes that do not apply to this event (the 54% reduction is an average of the reduction suggested by the NPRD-3 and NPRDS failure mode reviews).

All these sources combined provided a total of 29 failure rate estimates. These estimates were used to develop a distribution of motor

failure rates, and this distribution was used to develop conservative parameters of a lognormal distribution to be used in this study.

The median and error factor developed from this distribution are 7×10^{-6}/h and 20, respectively.

Pump Fails to Run - 0.26/yr (EF = 10)

WASH-1400 reports a failure rate of 3×10^{-5}/h with an error factor of 10. This estimate includes both the pump and the driver. SRS (Ref. 9-7, item code 69530) reports a slightly higher rate (5.4×10^{-5}/h) that is in good agreement given the large uncertainty assumed in the WASH-1400 estimate.

NPRDS (Ref. 9-6, pages 421 through 429) reports a total of 509 (<500 GPM) pump failures in about 2.3 million operational hours. The failure modes described in the NPRDS report were examined to screen those that do not apply to the event of interest (e.g., spurious operation). This review indicates that only about 147 of the 509 events can be associated with the failure mode of interest. Thus, the failure rate is about 6.4×10^{-5}/operational hour.

NPRD-3 (Ref. 9-5, page 215) reports a failure rate of 7.9×10^{-5}/ operating hour for oil pumps operating under less than ideal conditions, installed in permanent racks with adequate cooling air, and maintained by military personnel. However, the pump may occasionally be subject to shock and vibration. As for the NPRDS estimate, the failure modes described in the NPRD-3 report were reviewed, and only about 27% of the events were judged applicable to the failure mode of interest. Thus, the failure rate becomes about 2.1×10^{-5}/operating hour.

All estimates are in good agreement with the WASH-1400 estimate, and the latter was used in this study. The error factor proposed in the WASH-1400 is also adopted here because both the NPRDS and the NPRD-3

data bases show large variations among failure rate estimates for different pumps and/or for similar pumps at different facilities.

<u>Heater Fails Off</u> - 0.021/yr (EF = 10)

The Corps of Engineers (HND) R/M Data Base (Ref. 9-10, page 296) provides a 2.36/million hour failure rate estimate for a large (30 kw, 400 VAC), two stage heater. NPRD-3 (Ref. 9-5, page 207) provides a range from 0.4 to 3.5 failures per million operating hours for heaters operating under selected environmental conditions (data from GB environmental code only). NPRDS (Ref. 9-6, page 322) reports 18 heater failures in about 5 million operating hours. Thus, the NPRDS failure rate estimate is about 3.6×10^{-6}/h.

The estimate from the Corps of Engineers (HND) data base (Ref. 9-4) is judged more applicable here and will be used as the median for "heater fails off" event. An error factor of 10 is assumed due to the large uncertainties associated with the applicability of these estimates to the equipment of interest. Note that all estimates are in good agreement given the large uncertainty assumed for this failure rate.

<u>Loss of (Plant or Instrument) Air System</u> - 0.016/yr (EF = 10)

NPRDS (Ref. 9-6, page 49) reports no air system failures in about 398 thousand operating hours (approximately 3.2 million calendar hours). These statistics were compiled from 24 instrument and station service air systems in U.S. nuclear power plants. The median generated from these statistics is about 1.8×10^{-6}/operating hour (using a chi-square distribution).

There are large uncertainties regarding the similarity of the systems at this facility and the systems in the NPRDS data base, and thus, regarding the applicability of the NPRDS estimate to this facility. An error factor of 10 is judged adequate here.

<u>Switch, Generic--Spurious Operation</u> - 0.015/yr (EF = 19)

A review of available data bases (Refs. 9-5 through 9-8 and Refs. 9-11 through 9-13) revealed 53 failure rate estimates for a variety of switches (e.g., pressure, temperature, etc.). These estimates were used to develop a distribution of switch failure rates, and this distribution was used to develop conservative parameters of a lognormal distribution to be used in this study.

The median of switch failure rate estimates is about 3.4 failures per million operating hours. This rate was arbitrarily reduced by 50% to represent the fraction corresponding to the failure mode of interest, i.e., "spurious operation." This reduction is believed to be conservative. The distribution of switch failure rates suggests an error factor of 19.

<u>Controller (includes sensor, signal conditioning equipment, and control circuitry), Generic--Spurious Operation (high or low)</u> - 0.022/yr (EF = 12)

A review of available data bases (Refs. 9-5, 9-6, 9-8, 9-10, 9-12) revealed 19 failure rate estimates for a variety of controllers (e.g., pressure, thermostat, electronic, etc.). These estimates were used to develop a distribution of controller failure rates, and this distribution was used to develop conservative parameters of a lognormal distribution to be used in this study.

The median of the controller failure rate estimates is about five failures per million operating hours. This rate was reduced by 50% to represent the fraction corresponding to the failure mode of interest, i.e., "spurious operation" (functions without signal). This reduction is suggested in the IEEE Std. 500-1977 data base. The distribution of controller failure rates suggests an error factor of 12.

Pressure Controller (includes sensor, signal conditioning equipment, and control circuitry)--Spurious Operation (high or low) - 0.007/yr (EF = 12)

A review of available data bases (Refs. 9-5, 9-6, 9-10, 9-12) revealed seven failure rate estimates for pressure controllers. These estimates were used to develop a distribution of pressure controller failure rates.

The median of the pressure controller failure rate estimates is about 1.6 failures per million operating hours. This rate was reduced by 50% to represent the fraction corresponding to the failure mode of interest, i.e., "spurious operation." This reduction is suggested in the IEEE Std. 500-1977 data base.

The error factor for a generic controller, EF = 12, is adopted here for pressure controllers because the seven estimates available for pressure controller failure rates are judged insufficient to represent the spread of the distribution.

Pump Fails to Start - 5.1 x 10^{-3}/demand (EF = 10)

WASH-1400 suggests a 10^{-3}/demand probability of a pump failing to start, with an error factor of 10. This same estimate has been adopted in several other applications, including the Rijnmond study (Ref. 9-8, Table IX.I) and EGG-EA-5887 (Ref. 9-14, page 12). The WASH-1400 estimate is used in this study.

Also, a 4.1 x 10^{-3}/demand probability is added to this estimate to account for cable, circuit breaker (CB), and CB control circuit faults (Ref. 9-15, Table B.5-5).

Relief Valve Spuriously Opens - 0.01/yr (EF = 5)

WASH-1400 suggests a 10^{-5}/h (0.09/yr) estimate with an error factor of 3. A more recent study, EGG-EA-5887 (Ref. 9-39, page 18), proposes a lower, 10^{-2}/yr, estimate with the same error factor. The more recent estimate is assumed for this event, but the error factor has been increased to 5 to reflect uncertainties with respect to applicability of nuclear-related data to the demilitarization facility.

Beta-Factor, Generic - 0.14 (EF = 4)

A review of available literature and data bases (Ref. 9-11 and Refs. 9-16 through 9-21) on CCFs revealed 80 beta-factor estimates for a variety of equipment (e.g., pumps, diesel generators, instrumentation and control equipment, etc.). These estimates were used to develop a distribution of beta-factor values, and this distribution was used to develop conservative parameters of a lognormal distribution to be used in this study. The median of the beta-factor estimates is about 0.14 with an error factor of 4.

Solenoid Valve Beta-Factor - 0.15 (EF = 4)

The event "Solenoid Valve Fails to Operate on Demand" includes a contribution from the solenoid valve itself and a contribution from the valve relay.

The generic beta-factor, 0.14, was used for the solenoid valve, and the breaker beta-factor, 0.19 (Ref. 9-17), was used for the valve relay. The overall beta-factor for this event is the average of these two beta-factor estimates, weighted by their contribution to the event probability:

$$\beta = \frac{0.14 \times 10^{-3} + 0.19 \times 10^{-4}}{10^{-3} + 10^{-4}} = 0.15$$

Damper Beta-Factor - 0.14 (EF = 4)

The generic beta-factor was assumed applicable for dampers.

Loss of Offsite Power - 0.09/yr (EF = 5)

NUREG/CR-3992 (Ref. 9-22, Table 5.1) estimated the frequency of loss of offsite power to be 0.09/yr based on industry-wide U.S. nuclear power plant data for the years 1959 through 1983. This estimate was derived from plants with at least two offsite power connections (this includes most nuclear power generating plants). An error factor of 5 is subjectively assigned to this event.

Loss of Offsite Gas Supply - 0.01/yr (EF = 10)

This is a subjective estimate.

Spurious Signal Generated by Control System - 0.014/yr (EF = 10)

A plant specific analysis (Ref. 9-23) of a digital control system indicated a 1.6×10^{-6}/h frequency of spurious system operations resulting in a spurious signal to a specific component; e.g., commanding a valve to close, given appropriate inputs to the system. (This is not the total frequency of spurious system operations.) An error factor of 10 is assigned due to large uncertainties associated with the applicability of this estimate to the control system at the demilitarization facility.

Solenoid Valve Spuriously Closes - 0.0042/yr (EF = 10)

NUREG/CR-2770 (Ref. 9-21, page 92) estimated the frequency of motor-operated valves failing to remain open to be 4.8×10^{-7}/h. Review of the descriptions of the failure occurrences used in deriving this estimate shows that all spurious closings of valves were due to command

faults where a support function fault resulted in a spurious signal to close the valve (e.g., bad switch caused closing contact to stick). Thus, since this frequency estimate does not appear to depend on the type of driver, it is judged applicable to this event.

An error factor of 10 is assigned due to large uncertainties associated with the applicability of nuclear-related data to the demilitarization facility.

Check Valve Fails to Open - 10^{-4}/demand (EF = 5)

WASH-1400 provides a 10^{-4} probability of a check valve failing to open on demand, with an error factor of 3. The same estimate is proposed in EGG-EA-5887 (Ref. 9-14, page 13). NUREG/CR-2770 (Ref. 9-21, page 62) provides a 3.1×10^{-7}/calendar hour estimate. This estimate is consistent with the WASH-1400 estimate if the valve is tested monthly.

The WASH-1400 estimate is assumed for this event, but the error factor is increased to 5 to reflect uncertainties associated with the applicability of nuclear-related data to the demilitarization facility.

Control (Modulating) Valve Spuriously Opens or Closes - 0.0042/yr (EF = 10)

The same estimate for "Solenoid Valve Spuriously Closes" is used here. The large uncertainty range (EF = 10) is considered sufficient to accommodate equipment variability.

Note: Spurious signals generated by the control system are not included in this estimate.

<u>Damper Spuriously Closes</u> - 0.0042/yr (EF = 10)

The same estimate for "Solenoid Valve Spuriously Closes" is used here. The large uncertainty range (EF = 10) is considered sufficient to accommodate equipment variability.

<u>Pressure Controller Diaphragm Valve Fails (open or closed)</u> - 0.013/yr (EF = 10)

The Corps of Engineers (HND) R/M Data Base (Ref. 9-10, pages 1037, 1038) provides an estimate of 3×10^{-6}/h for the frequency of failure of pressure regulation valves. A 50% chance of failing either open or closed is assumed here. The assumed error factor is 10.

<u>Level Indicator--Spurious Operation</u> - 0.06/yr (EF = 4)

A review of available data bases (Refs. 9-5 through 9-8, and Ref. 9-12) revealed ten failure rate estimates for level switches, level sensors, and level transmitters. These estimates were used to develop a distribution of level indicator failure rates, and this distribution was used to develop conservative parameters of a lognormal distribution to be used in this study.

The median of level indicator failure rate estimates is about 0.12 failures per operating year. This rate was arbitrarily reduced by 50% to represent the fraction corresponding to the failure mode of interest, i.e., "spurious operation." This reduction is believed to be conservative. The distribution of level indicator failure rates suggests an error factor of 4.

<u>Temperature Detector--Spurious Operation</u> - 0.095/yr (EF = 6)

A review of available data bases (Refs. 9-5 through 9-8, 9-12, and 9-13) revealed seventeen failure rate estimates for temperature switches, temperature indicators, and temperature transducers. These

estimates were used to develop a distribution of temperature detector failure rates, and this distribution was used to develop conservative parameters of a lognormal distribution to be used in this study.

The median of temperature detector failure rate estimates is about 0.19 failures per operating year. This rate was arbitrarily reduced by 50% to represent the fraction corresponding to the failure mode of interest, i.e., "spurious operation"; this reduction is believed to be conservative. The distribution of temperature detector failure rates suggests an error factor of 6.

Solenoid Valve Fails to Operate on Demand - 1.1×10^{-3}/demand (EF = 5)

The IREP data base (Ref. 9-24) proposes a 10^{-3}/demand probability for this event, with an error factor of 3. The IREP estimate is adopted in this study, but the error factor has been increased to 5 to reflect the uncertainty associated with the applicability of the IREP data to the demilitarization plant equipment. Also, a 10^{-4}/demand probability is added to this estimate to account for the valve relay failure to open on demand (see Relay/Breaker Fails to Operate).

Pressure Switch--Spurious Operation - 0.037/yr (EF = 5)

A review of available data bases (Refs. 9-5 through 9-8, 9-11, 9-13, 9-24, and 9-25) revealed thirteen failure rate estimates for a variety of pressure switches. These estimates were used to develop a distribution of pressure switch failure rates, and this distribution was used to develop conservative parameters of a lognormal distribution to be used in this study.

The median of pressure switch failure rate estimates is about 0.074 failures per operating year. This rate was arbitrarily reduced by 50% to represent the fraction corresponding to the failure mode of interest, i.e., "spurious operation"; this reduction is believed to be conserva-

tive. The distribution of pressure switch failure rates suggests an error factor of 5.

<u>Damper Fails to Operate on Demand</u> - 1.1×10^{-3}/demand (EF = 10)

The same probability assumed for a solenoid valve failing to operate on demand is used here. The error factor has been increased to 10 to account for equipment differences.

<u>Relay/Breaker Spuriously Open</u> - 8.8×10^{-5}/yr (EF = 10)

The IREP data base (Ref. 9-24, Table 5.1-1) proposes a failure rate of 10^{-8}/h for loss of an electrical bus, with an error factor of 10. The loss of a bus event is dominated by failure of the supply breaker; thus the IREP estimate is used here for a relay/breaker spuriously opening.

<u>Relay/Breaker Fails to Operate</u> - 10^{-4}/demand (EF = 10)

The IREP data base (Ref. 9-24, Table 5.1-1) proposes a 10^{-4}/demand probability of a relay failing to operate on demand, with an error factor of 10.

<u>Circuit Breaker Fails to Operate</u> - 10^{-3}/demand (EF = 10)

The IREP data base (Ref. 9-24, Table 5.1-1) proposes a 10^{-3}/demand probability of a circuit breaker failing to operate on demand, with an error factor of 10.

<u>Solid State Relay Fails to Operate</u> - 1.8×10^{-4}/demand (EF = 5)

MIL-HDBK-217D (Ref. 9-25) provides a failure rate estimate of 0.5×10^{-6}/h for a solid state (thyristor) relay (assuming GF conditions in Table 5-2-10 and a quality factor of 5 in Table 5-2-11). This estimate

results, with an assumed monthly test scheme, in a 1.8×10^{-4} probability of failure on demand. The assumed error factor for this event is 5.

9.1.4. <u>Handling Accident Data</u>

All initiating event frequency accidents, except for forklift collisions, were derived from the human reliability analysis and are discussed in Section 9.2.

The forklift collision accident frequency was derived from Ref. 9-2. In Ref. 9-2, accidents were defined to include incidents that result in fatalities, injuries, or property damage. The basic truck accident rate is 2.5×10^{-6} accidents/mile. From Table II of Ref. 9-2, the percent of accidents leading to collisions with trucks, autos, and stationary objects and overturns is 89.35%. Table III of Ref. 9-2 also show that 50% of all accidents occur at 30 to 40 mph.

To convert the basic rate to accidents per operation, the operator's exposure time in the highway is determined. If the operator was traveling at 35 mph, the exposure time is 1.7 min.

In order to apply this information to forklift collision accidents, the following were assumed:

1. The total operator exposure time during the forklift operation is 10 min. This includes the lifting of munitions from the stack, moving them to another area, and unloading them.

2. The time to travel from one point to another is assumed to be one-third of the total time, or 3.3 min.

3. Forklift collisions will occur at speeds no greater than 40 mph (i.e., two forklifts traveling at 20 mph).

Therefore, forklift collision accident rate is:

$$2.5 \times 10^{-6} \times 0.893 \times \frac{3.3}{1.7} = 4.3 \times 10^{-6}/\text{operation} \quad .$$

This median value is assigned an error factor of 10 on the basis that the data is only for 6 yr and there may be other unreported incidents more directly related to forklift operations.

Reference 9-2 also indicates that 25% of fires result from collision-type accidents. It is not evident from the data if fire from collision is directly proportional to truck speed. Our analysis assumes that it is. Therefore, we modified the data as follows:

$$\text{Probability of fire} = 0.25 \times 0.29 = 0.0725 \quad ,$$

where the factor 0.29 represents the percent of collisions occurring at less than 20 mph.

9.2. HUMAN FACTORS DATA

9.2.1. Human-Error Probability Estimation - Handling Accidents

Human-error probabilities were quantified using the approach to human-error estimation described in NUREG/CR-1278 (Ref. 9-26), probabilities of human errors were estimated based on several performance-shaping factors such as munition configuration, handling operation, clothing level, and crew size. These factors are identified in the discussions that follow on the derivations of each estimate. Table 9-8 lists the error probabilities estimated for puncturing or dropping a munition based on each of these factors. These error probabilities will be incorporated into the handling scenarios as shown in the data tables in Table 6-4.

1. Puncturing a munition. The basis for the error estimates is taken from Section 4.4.2 of Ref. 9-27 (pages 4.4 through 4.26). This reference gives 4×10^{-5} as a data-based estimate of the probability of handling errors using forklifts for the rocket stockpile. This is an estimate of the likelihood of an error in forklift operation that potentially could lead to a warhead rupture while attempting to isolate a leaking rocket inside the storage igloo.

   That estimate is based on conditions that do not entirely represent those assumed by this study; namely, that a three-man crew will perform all forklift operations. In this study, it is assumed that a two-man crew will perform all forklift operations--one driving the forklift and one guiding forklift and munition position from the ground. This means that the data-based estimate may not represent the probability of forklift-handling errors expected under actual conditions. Therefore, this estimate was revised to 1×10^{-4} to account

TABLE 9-8
HUMAN ERROR PROBABILITIES PER HANDLING OPERATION

Error Type For Munition Configuration	Handling Operation for Clothing Type: Level A or DPE		Levels B, C, and D (Mask, Gloves, and Boots)		Levels E and F (Street Clothes, Mask Slung)	
	Hand Carry(a)	Forklift	Hand Carry(a)	Forklift	Hand Carry(a)	Forklift
Tine Carried						
Drop	6.0×10^{-4}	3.0×10^{-4}	3.0×10^{-4}	1.5×10^{-4}	6.0×10^{-5}	3.0×10^{-5}
Puncture	NA	1.0×10^{-4}	NA	5.0×10^{-5}	NA	1.0×10^{-5}
Beam Carried						
Drop	NA	3.0×10^{-5}	NA	1.5×10^{-5}	NA	3.0×10^{-6}
Puncture	NA	NA	NA	NA	NA	NA

(a) Hand-carry operations involve one weapon at a time.

for a smaller crew. The revised estimate of 1×10^{-4} is the probability that one or both members of a two-man crew will err such that the forklift tine is in a position to puncture a munition. (This puncture probability applies to those cases in which forklift tines are used to lift munitions; it includes palletized munitions and spray tanks in overpacks.)

Another difference is that the original estimate from Ref. 9-27 (4×10^{-5}) was based on operations with leaking rockets. This meant that it assumes that the crew is wearing Level A protective clothing. If the same forklift operations are performed in less strenuous circumstances (i.e., if a lower level of protective clothing is worn), the error probability estimate can be lowered. Here, it has been lowered to 5×10^{-5} for the case of the operators' wearing partial protection (masks, gloves, and boots) and to 1×10^{-5} for the case of their wearing minimal protection (street clothes, with masks slung).

2. Dropping a munition. For palletized munitions and spray tanks in their overpacks, human-caused drops from forklifts are judged to be three times as likely as punctures caused by operating the same kind of forklift. The error-probability estimates are 3×10^{-4}, 1.5×10^{-5}, and 3×10^{-5} for dropping a munition from a forklift tine when wearing Level A, Level C, or Level F protective clothing, respectively.

Because of unwieldy pallet and overpacked spray tank loads, and because it is assumed that forklift-tine loads are likely to be carried at higher speeds than are forklift-beam loads, the likelihood of a ton container or other beam-carried loads being dropped because of human error is judged to be an order of magnitude lower than that of a tine-carried load being dropped. These are estimated to be 3×10^{-5}, 1.5×10^{-6}, and

3×10^{-6} for protective clothing Levels A, C, and F, respectively.

For hand-carried munitions, munition drops are estimated to be twice as likely as drops of tine-carried load from forklifts. The estimated probabilities of dropping a hand-carried munition when wearing Levels A, C, and F protective clothing are 6×10^{-4}, 3×10^{-4}, and 6×10^{-5}, respectively. (Loads carried by forklift beams are never hand carried.)

These probability estimates are the likelihood of an error per handling operation. A single forklift operation may involve a single munition such as a spray tank or as many as 48 weapons on a pallet, while a single hand-carry operation will always involve only a single munition.

3. Failing to detect a leaking munition in a package. The probability of an operator's failing to detect a leak is based on his failing to monitor an OFC before opening it. The error probability is estimated as 1×10^{-3} based on item 9 from Table 20 through 22 of NUREG/CR-1278 (Ref. 9-26). This human-error probability is the probability that a checker will fail to check equipment status when that status affects the checker's own safety. Since the continers are loaded elsewhere (or at least by other operators), the unloader should be cautious when handling them; he has no way to ensure a "clean" vault interior, so he will probably want to protect himself. This error estimates that the operator is likely to overlook this check on one out of every thousand vaults or transportation containers that he opens.

9.2.2. Human-Reliability Analysis for Plant Operations

The human-reliability analysis (HRA) for plant operations was conducted as an input to the plant operations internal events analysis. This section describes the scope of the HRA, the methodology used, the screening performed, and the final quantification.

9.2.2.1. Scope. The preliminary fault-tree and event-tree models for plant operations were examined to identify human actions that had the potential to mitigate agent release. For screening, these human actions were categorized and assigned conservative human-error probabilities. Once the plant operations scenarios had been screened on the basis of frequency and consequence, the survivors were examined in greater detail to identify important human actions and to identify plant/operating system characteristics that could influence human-error probabilities. The important human actions were quantified, taking this information into account, and were integrated into the final fault-tree and event-tree models.

9.2.2.2. Methodology. Screening and final estimates of human-error probabilities were obtained by using the Technique for Human Reliability Analysis (THERP) as described in NUREG/CR-1278 (Ref. 9-26). This technique calls for identifying individual human errors and for describing the set of performance-shaping factors (PSFs) that pertain to each task situation. Usually, such descriptions are very task-, site-, and situation-specific. In this case, since there was no finished, approved human-performance system to analyze, more generic descriptions of task situations were used. That is, several assumptions about what could be realistically expected for a generic CONUS site were made, since there are, as yet, no written procedures for CONUS, no site-specific man-machine interface, no training program beyond the conceptual stage, and no finished plant design (except that for JACADS) that allows for time data to be collected. The human-reliability analysis for plant operations was based on these assumptions, which are listed in Appendix E.

9.2.2.3. Screening. To screen the plant-operations scenarios, generic human-error events were defined. The plant-operations logic models (fault trees and event trees) were examined to identify appropriate areas for considering the human-error contribution to release frequencies. At appropriate places on these logic models, one or more of the generic human-error events were placed, or it was determined that the human-error contribution had already been taken into account there implicitly.

Conservative human-error probabilities were estimated for each of the error events. The conservative estimates may be considered to represent the upper bound of a worst-case human-action situation. The screening human-error events are described in Table 9-9 along with the data source for each error probability. In general, the HEPs used for screening purposes are either (1) factors of 3 to 10 higher than the upper bounds reported in Ref. 9-73, (2) taken to be 1.0 or (3) assumed conservative values based on analyst experience and scientific judgment. Once these conservative values had been used in the quantitative scenario screening, more realistic human-error probabilities were estimated for the surviving scenarios.

9.2.2.4. Final Quantification. A preliminary draft of the event trees was examined to identify any human actions that might serve as initiators to, or mitigators of, accident scenarios. Those human actions were categorized according to the system or equipment interface dealt with by the operators. (As is usual with other risk assessments, human errors in maintenance activities were not quantified explicitly since those errors contribute to the already-estimated hardware-failure probabilities.) Table 9-10 lists those human actions in scenario-identifier order.

For final quantification, this list was grouped according to error types. Ten error types were identified that focus on: ignition, fire

TABLE 9-9
SCREENING QUANTIFICATION FOR HUMAN-RELIABILITY ANALYSIS OF PLANT OPERATIONS

Index	Error Event	HEP	Source[a]
1	Operator fails to respond to an alarm indication. Correct response is in the control room and may include taking simple control action or initiating emergency shutdown.	1×10^{-1}	Table 20-23, item 2b (factor of 10 higher than upper bound)
2	Operator fails to respond to an alarm indication. Correct response is outside the control room, and Decontamination Protective Ensemble (DPE) may be required.	3×10^{-1}	(Factor of 3 above Index 1)
3	Operator fails to notice a malfunction or existing condition on the closed-circuit TV screen. He fails to shut the operation down as a result.	5×10^{-1}	Table 20-10, item 7 (upper bound (or Table 20-22, item 4 (factor of 10 above upper bound)
4	Operator fails to monitor the operating system. He fails to carry out a required action such as closing a valve or closing a blast door.	3×10^{-1}	Table 20-6, item 2 (factor of 10 above upper bound)
5	Operator shuts down, disables, or delays the operation of a safety system. This could be because he misinterprets system status or because the information he received is incorrect or incomplete.	1×10^{-1}	Table 20-3, item 2 (by 10 minutes after signal)
6	Operator takes action that initiates a fire or some other sequence of catastrophic events.	1×10^{-2}	Scientific judgment
7	Operator fails to take action to mitigate fire. He fails to close the dampers.	1.0	Table 20-3, item 2 (by 10 minutes, upper bound)
8	Operator fails to implement action to recover from upset condition.	1.0	Scientific judgment

TABLE 9-9 (Continued)

Index	Error Event	HEP	Source[a]
9	Maintainer fails to perform tasks, to perform them correctly, or to perform them on time.	3×10^{-1}	Table 20-6, item 7
10	Operator fails to carry out administrative control policy. He fails to initiate a regularly scheduled action or fails to follow standard operating procedure.	5×10^{-1}	Table 20-6, item 1 (factor of 10 above upper bound)
11	Operator selects wrong component to operate.	5×10^{-2}	Table 20-12, item 2 (factor of 5 above upper bound)
12	Operator drops or damages munition while controlling it manually, lifting or carrying it with a forklift, or carrying it by hand.	3×10^{-1}	Scientific judgment

[a]Unless stated otherwise, all tables and item numbers refer to NUREG/CR-1278 (Ref. 9-26).

TABLE 9-10
HUMAN-ERROR EVENTS BY SEQUENCE

No.	Error Events	Area	Munition	Sequence
1	Conveyor Loading	ECV	Ton Container	ECV-1
2	Ignition	ECV	Ton Container	ECV-1
3	Fire Suppression	ECV	Ton Container	ECV-1
4	Ventilation System	ECV	Ton Container	ECV-1
5	Conveyor Loading	ECV	Ton Container	ECV-2
6	Ignition	ECV	Ton Container	ECV-2
7	Fire Suppression	ECV	Ton Container	ECV-2
8	Conveyor Loading	ECV	M55 Rocket	ECV-3
9	Conveyor Loading	ECV	M55 Rocket	ECV-4
10	Fire Suppression	ECV	M55 Rocket	ECV-4
11	Conveyor Loading	ECV	M55 Rocket	ECV-5
12	Fire Suppression	ECV	M55 Rocket	ECV-5
13	Conveyor Loading	ECV	Mine	ECV-6
14	Conveyor Loading	ECV	Mine	ECV-7
15	Fire Suppression	ECV	Mine	ECV-7
16	Conveyor Loading	ECV	Mine	ECV-8
17	Fire Suppression	ECV	Mine	ECV-8
18	Conveyor Loading	ECV	8" Projectile	ECV-9
19	Conveyor Loading	ECV	8" Projectile	ECV-10
20	Fire Suppression	ECV	8" Projectile	ECV-10
21	Conveyor Loading	ECV	8" Projectile	ECV-11
22	Fire Suppression	ECV	8" Projectile	ECV-11
23	Conveyor Loading	ECV	105-mm Projectile	ECV-12
24	Conveyor Loading	ECV	105-mm Projectile	ECV-13
25	Fire Suppression	ECV	105-mm Projectile	ECV-13
26	Conveyor Loading	ECV	105-mm Projectile	ECV-14
27	Fire Suppression	ECV	105-mm Projectile	ECV-14
28	Conveyor Loading	ECV	105-mm Projectile	ECV-15
29	Conveyor Loading	ECV	105-mm Projectile	ECV-16
30	Fire Suppression	ECV	105-mm Projectile	ECV-16
31	Conveyor Loading	ECV	105-mm Projectile	ECV-17
32	Fire Suppression	ECV	105-mm Projectile	ECV-17
33	Undrained Munition	ECR	Mine	ECR-1DM
34	Ventilation System	ECR	Mine	ECR-1DM
35	Undrained Munition	ECR	Mine	ECR-2DM
36	Ventilation System	ECR	Mine	ECR-2DM
37	Undrained Munition	ECR	Mine	ECR-3DM
38	Ignition	ECR	Mine	ECR-3DM
39	Fire Suppression	ECR	Mine	ECR-3DM
40	Ventilation System	ECR	Mine	ECR-3DM
41	Undrained Munition	ECR	Mine	ECR-4DM
42	Fire Suppression	ECR	Mine	ECR-4DM
43	Ventilation System	ECR	Mine	ECR-4DM
44	Undrained Munition	ECR	Projectile	ECR-1DP
45	Ventilation System	ECR	Projectile	ECR-1DP
46	Undrained Munition	ECR	Projectile	ECR-2DP
47	Ventilation System	ECR	Projectile	ECR-2DP
48	Undrained Munition	ECR	Projectile	ECR-3DP
49	Fire Suppression	ECR	Projectile	ECR-3DP
50	Ventilation System	ECR	Projectile	ECR-3DP
51	Undrained Munition	ECR	Projectile	ECR-4DP
52	Fire Suppression	ECR	Projectile	ECR-4DP

TABLE 9-10 (Continued)

No.	Error Events	Area	Munition	Sequence
53	Ventilation System	ECR	Projectile	ECR-4DP
54	Undrained Munition	ECR	Rocket	ECR-1DR
55	Ventilation System	ECR	Rocket	ECR-1DR
56	Undrained Munition	ECR	Rocket	ECR-2DR
57	Fire Suppression	ECR	Rocket	ECR-2DR
58	Ventilation System	ECR	Rocket	ECR-2DR
59	Undrained Munition	ECR	Rocket	ECR-3DR
60	Fire Suppression	ECR	Rocket	ECR-3DR
61	Ventilation System	ECR	Rocket	ECR-3DR
62	Undrained Munition	ECR	Rocket	ECR-4DR
63	Fire Suppression	ECR	Rocket	ECR-4DR
64	Undrained Munition	ECR	Rocket	ECR-5DR
65	Ventilation System	ECR	Rocket	ECR-5DR
66	Undrained Munition	ECR	Rocket	ECR-6DR
67	Fire Suppression	ECR	Rocket	ECR-6DR
68	Ventilation System	ECR	Rocket	ECR-6DR
69	Undrained Munition	ECR	Rocket	ECR-7DR
70	Fire Suppression	ECR	Rocket	ECR-7DR
71	Ventilation System	ECR	Rocket	ECR-7DR
72	Spurious Drain	MPB	Bulk Container	MPB-2B
73	Ignition	MPB	Bulk Container	MPB-2B
74	Fire Suppression	MPB	Bulk Container	MPB-2B
75	Ventilation System	MPB	Bulk Container	MPB-2B
76	Spurious Drain	MPB	Bulk Container	MPB-3B
77	Ignition	MPB	Bulk Container	MPB-3B
78	Fire Suppression	MPB	Bulk Container	MPB-3B
79	Ventilation System	MPB	Bulk Container	MPB-3B
80	Spurious Drain	MPB	Bulk Container	MPB-4B
81	Fire Suppression	MPB	Bulk Container	MPB-4B
82	Spurious Drain	MPB	Bulk Containers	MPB-5B
83	Fire Suppression	MPB	Bulk Containers	MPB-5B
84	Ventilation System	MPB	Bulk Containers	MPB-5B
85	Spurious Drain	MPB	Bulk Containers	MPB-6B
86	Fire Suppression	MPB	Bulk Containers	MPB-6B
87	Undrained Munition	MPB	Projectile	MPB-1DP
88	Ventilation System	MPB	Projectile	MPB-1DP
89	Undrained Munition	MPB	Projectile	MPB-2DP
90	Fire Suppression	MPB	Projectile	MPB-2DP
91	Ventilation System	MPB	Projectile	MPB-2DP
92	Undrained Munition	MPB	Projectile	MPB-3DP
93	Fire Suppression	MPB	Projectile	MPB-3DP
94	Ventilation System	MPB	Projectile	MPB-3DP
95	Conveyor Loading	BSA	Ton Container	BSA-1
96	Ignition	BSA	Ton Container	BSA-1
97	Fire Suppression	BSA	Ton Container	BSA-1
98	Undrained Munition	BSA	Ton Container	BSA-2
99	Conveyor Loading	BSA	Ton Container	BSA-2
100	Ignition	BSA	Ton Container	BSA-2
101	Fire Suppression	BSA	Ton Container	BSA-2
102	Ventilation System	BSA	Ton Container	BSA-2
103	Sump Pump Operation	TOX	Agent Tank	TOX-2
104	Fire Suppression	TOX	Agent Tank	TOX-2

TABLE 9-10 (Continued)

No.	Error Events	Area	Munition	Sequence
105	Ventilation System	TOX	Agent Tank	TOX-2
106	Sump Pump Operation	TOX	Agent Tank	TOX-3
107	Fire Suppression	TOX	Agent Tank	TOX-3
108	Ventilation System	TOX	Agent Tank	TOX-3
109	Fire Suppression	TOX	Agent Tank	TOX-4
110	Sump Pump Operation	TOX	Agent Tank	TOX-5
111	Fire Suppression	TOX	Agent Tank	TOX-5
112	Ventilation System	TOX	Agent Tank	TOX-5
113	Sump Pump Operation	TOX	Agent Tank	TOX-6
114	Fire Suppression	TOX	Agent Tank	TOX-6
115	Tank Overfill	TOX	Agent Tank	TOX-8
116	Fire Suppression	TOX	Agent Tank	TOX-8
117	Ventilation System	TOX	Agent Tank	TOX-8
118	Tank Overfill	TOX	Agent Tank	TOX-9
119	Fire Suppression	TOX	Agent Tank	TOX-9
120	Shutdown Signal	LIC	All Munitions	LI1-001
121	Stop Fuel	LIC	All Munitions	LI2-001
122	Stop Combustion	LIC	All Munitions	LI2-002
123	Stop Fuel	LIC	All Munitions	LI2-005
124	Shutdown Signal	MPF	Bulk, Projectiles	MP1-001, MP2-005
125	Shutdown Signal	MPF	Bulk, Projectiles	MP2-001, MP2-003
126	Stop Fuel	MPF	Bulk, Projectiles	MP2-002
127	Shutdown Signal	MPF	Bulk, Projectiles	MP2-004
128	Undrained Munition	MPF	Bulk, Projectiles	MP3-001
129	Shutdown Signal	MPF	Bulk, Projectiles	MP3-001
130	Undrained Munition	MPF	Bulk, Projectiles	MP3-002
131	Undrained Munition	MPF	Bulk, Projectiles	MP3-003
132	Undrained Munition	MPF	Bulk, Projectiles	MP3-004
133	Undrained Munition	MPF	Bulk, Projectiles	MP4-001
134	Shutdown Signal	MPF	Bulk, Projectiles	MP4-001
135	Shutdown Signal	MPF	Bulk, Projectiles	MP4-002, MP4-004
136	Stop Fuel	MPF	Bulk, Projectiles	MP4-003
137	Stop Combustion	MPF	Bulk, Projectiles	MP4-005
138	Shutdown Signal	DFS	Bursters, Rockets, Mines	DF1-001, DF2-005
139	Shutdown Signal	DFS	Bursters, Rockets, Mines	DF2-001, DF2-003
140	Stop Fuel	DFS	Bursters, Rockets, Mines	DF2-002
141	Stop Combustion	DFS	Bursters, Rockets, Mines	DF2-004
142	Stop Agent	DFS	Bursters, Rockets, Mines	DF2-006
143	Shutdown Signal	DFS	Bursters, Rockets, Mines	DF2-006
144	Fast Feed	DFS	Bursters, Rockets, Mines	DF3-001
145	Shutdown Signal	DFS	Bursters, Rockets, Mines	DF4-001
146	Shutdown Signal	DFS	Bursters, Rockets, Mines	DF5-001, DF5-003
147	Shutdown Signal	DFS	Bursters, Rockets, Mines	DF5-001, DF5-003
148	Stop Fuel	DFS	Bursters, Rockets, Mines	DF5-002
149	Shutdown Signal	DFS	Bursters, Rockets, Mines	DF5-002
150	Stop Fuel	DFS	Bursters, Rockets, Mines	DF5-004
151	Stop Agent	DFS	Bursters, Rockets, Mines	DF5-005
152	Munition Counting	DUN	All Munitions	DU1-001
153	Munition Counting	DUN	All Munitions	DU1-002
154	Munition Counting	DUN	All Munitions	DU1-003
155	Munition Counting	DUN	All Munitions	DU1-004

suppression, conveyor loading, munition counting, tank overfill, sump pump operation, undrained munition, furnace ventilation, ventilation system, and air compressors. Table 9-11 shows the error events, the area of the plant involved, the munition type involved, the scenario identifier, the error probability, and the error factor associated with each quantification. The data sources for the error types are described below. The data represent medians and error factors of lognormal distributions.

9.2.2.4.1. Ignition. The operator or maintainer could serve as an ignition source in some areas of the plant. For the operators, the credible cases consist of those geographical areas in which he works or traffics. These include the control room, the receiving site Unpack Area (UPA), the Instrumentation and Electric Power room (IEP), and the observation corridors. For the maintainers, these include all areas (although his entry into most areas may be limited to down times). Operators and maintainers could initiate ignition by using an ignition source in the area (e.g., by smoking or welding) or by causing sparks (e.g., by dropping a munition or other object that could create sparks). The first of these will be controlled administratively throughout the plant; the operators will only be allowed to smoke in the control room and outdoors.

For plant areas requiring the wearing of Level C or higher protective clothing, masks must be worn; this physically rules out smoking in these areas. Therefore, smoking as an initiator is credible only in the control room and in the IEP, where Levels E and D, respectively, are required. Smoking even in these areas is a failure of administrative control.

The lower bound of a failure of administrative control is 0.002 (Ref. 9-26, Table 20-6, item 1). The likelihood of a checker's failing to check something when his own safety is involved is 1×10^{-3} (Ref. 9-26, Table 20-22, item 9). The second value was selected as

TABLE 9-11
HUMAN-ERROR EVENTS FOR FINAL QUANTIFICATION

No.	Error Events	Area	Munition	Scenario	Sequence	Error Probability 5 Min	Error Probability 10 Min	Error Probability 15 Min	EF
1	Ignition	MPB	Bulk Container		MPB-2B	epsilon			10
2	Ignition	MPB	Bulk Container		MPB-3B	epsilon			10
3	Ignition	ECR	Mine		ECR-3DM	6E-4			10
4	Ignition	BSA	Ton Container		BSA-2	epsilon			10
5	Ignition	ECV	Ton Container		ECV-1	epsilon			10
6	Ignition	ECV	Ton Container	POTAF 043	ECV-2	epsilon			10
7	Ignition	BSA	Ton Container	POKAF 053	BSA-1	epsilon			10
8	Fire Suppression	TOX	Agent Tank		TOX-4	5E-3	2E-4	5E-5	10
9	Fire Suppression	TOX	Agent Tank		TOX-5	5E-3	2E-4	5E-5	10
10	Fire Suppression	TOX	Agent Tank		TOX-9	5E-3	2E-4	5E-5	10
11	Fire Suppression	TOX	Agent Tank		TOX-3	5E-3	2E-4	5E-5	10
12	Fire Suppression	TOX	Agent Tank		TOX-8	5E-3	2E-4	5E-5	10
13	Fire Suppression	TOX	Agent Tank		TOX-6	5E-3	2E-4	5E-5	10
14	Fire Suppression	MPB	Bulk Container		MPB-2B	4E-2	1E-2	4E-3	10
15	Fire Suppression	MPB	Bulk Container	POKAF 051	MPB-4B	4E-2	1E-2	4E-3	10
16	Fire Suppression	MPB	Bulk Container		MPB-3B	4E-2	1E-2	4E-3	10
17	Fire Suppression	ECV	M55 Rocket	PORAC 046	ECV-5	4E-2	1E-2	4E-3	10
18	Fire Suppression	ECV	M55 Rocket	PORAC 045	ECV-4	4E-2	1E-2	4E-3	10
19	Fire Suppression	ECV	Mine	POMVC 045	ECV-7	4E-2	1E-2	4E-3	10
20	Fire Suppression	ECR	Mine		ECR-4DM	4E-2	1E-2	4E-3	10
21	Fire Suppression	ECV	Mine	POMVC 046	ECV-8	4E-2	1E-2	4E-3	10
22	Fire Suppression	ECR	Mine		ECR-3DM	4E-2	1E-2	4E-3	10
23	Fire Suppression	MPB	Bulk Containers		MPB-6B	4E-2	1E-2	4E-3	10
24	Fire Suppression	MPB	Bulk Containers		MPB-5B	4E-2	1E-2	4E-3	10
25	Fire Suppression	MPB	Projectile		MPB-2DP	4E-2	1E-2	4E-3	10
26	Fire Suppression	ECR	Projectile	POPAC 048	ECR-3DP	4E-2	1E-2	4E-3	10
27	Fire Suppression	ECR	Projectile		ECR-4DP	4E-2	1E-2	4E-3	10
28	Fire Suppression	MPB	Projectile		MPB-3DP	4E-2	1E-2	4E-3	10
29	Fire Suppression	ECR	Rocket		ECR-7DR	4E-2	1E-2	4E-3	10
30	Fire Suppression	ECR	Rocket	PORAC 049	ECR-4DR	4E-2	1E-2	4E-3	10
31	Fire Suppression	ECR	Rocket		ECR-3DR	4E-2	1E-2	4E-3	10
32	Fire Suppression	ECR	Rocket	PORAC 048	ECR-6DR	4E-2	1E-2	4E-3	10
33	Fire Suppression	ECR	Rocket		ECR-2DR	4E-2	1E-2	4E-3	10
34	Fire Suppression	BSA	Ton Container		BSA-2	4E-2	1E-2	4E-3	10
35	Fire Suppression	ECV	Ton Container		ECV-1	4E-2	1E-2	4E-3	10

TABLE 9-11 (Continued)

No.	Error Events	Area	Munition	Scenario	Sequence	Error Probability 5 Min	10 Min	15 Min	EF
36	Fire Suppression	ECV	Ton Container	POTAF 043	ECV-2	4E-2	1E-2	4E-3	10
37	Fire Suppression	BSA	Ton Container	POKAF 053	BSA-1	4E-2	1E-2	4E-3	10
38	Conveyor Loading	ECV	105-mm Projectile	POPAC 045	ECV-13	3.3E-4			10
39	Conveyor Loading	ECV	105-mm Projectile	POPAC 046	ECV-14	3.3E-4			10
40	Conveyor Loading	ECV	105-mm Projectile	POPAC 046	ECV-17	3.3E-4			10
41	Conveyor Loading	ECV	105-mm Projectile	POPAC 045	ECV-16	3.3E-4			10
42	Conveyor Loading	ECV	105-mm Projectile	POPAC 044	ECV-12	3.3E-4			10
43	Conveyor Loading	ECV	105-mm Projectile	POPAC 044	ECV-15	3.3E-4			10
44	Conveyor Loading	ECV	8" Projectile	POPAC 046	ECV-11	3.3E-4			10
45	Conveyor Loading	ECV	8" Projectile	POPAC 045	ECV-10	3.3E-4			10
46	Conveyor Loading	ECV	8" Projectile	POPAC 044	ECV-9	3.3E-4			10
47	Conveyor Loading	ECV	M55 Rocket	PORAC 045	ECV-4	3.3E-4			10
48	Conveyor Loading	ECV	M55 Rocket	PORAC 046	ECV-5	3.3E-4			10
49	Conveyor Loading	ECV	M55 Rocket	PORAC 044	ECV-3	3.3E-4			10
50	Conveyor Loading	ECV	Mine	POMVC 044	ECV-6	3.3E-4			10
51	Conveyor Loading	ECV	Mine	POMVC 045	ECV-7	3.3E-4			10
52	Conveyor Loading	ECV	Mine	POMVC 046	ECV-8	3.3E-4			10
53	Conveyor Loading	ECV	Ton Container		ECV-1	1.65E-5			10
54	Conveyor Loading	ECV	Ton Container	POTAF 043	ECV-2	1.65E-5			10
55	Conveyor Loading	BSA	Ton Container		BSA-2	1.65E-5			10
56	Conveyor Loading	BSA	Ton Container	POKAF 053	BSA-1	1.65E-5			10
57	Munition Counting	MDB	Mine		DU1-001	epsilon			NA
58	Munition Counting	MDB	Mine		DU1-003	epsilon			NA
59	Munition Counting	MDB	Mine		DU1-002	epsilon			NA
60	Munition Counting	MDB	Mine		DU1-004	epsilon			NA
61	Tank Overfill	TOX	Agent Tank		TOX-8	1E-3			10
62	Tank Overfill	TOX	Agent Tank		TOX-9	1E-3			10
63	Sump Pump Operation	TOX	Agent Tank		TOX-5	5E-2			10
64	Sump Pump Operation	TOX	Agent Tank		TOX-6	5E-2			10
65	Undrained Munition	MDB	Ton Container		MP3-002	1.1E-4			10
66	Undrained Munition	MDB	Ton Container		MP3-004	1.1E-4			10
67	Undrained Munition	MDB	Ton Container		MP4-001	1.1E-4			10
68	Undrained Munition	MDB	Ton Container		MP3-001	1.1E-4			10
69	Undrained Munition	MDB	Ton Container		MP3-003	1.1E-4			10
70	Undrained Munition	BSA	Ton Container		BSA-2	1E-2			10

TABLE 9-11 (Continued)

No.	Error Events	Area	Munition	Scenario	Sequence	Error Probability 5 Min	10 Min	15 Min	EF
71	Ventilation System	TOX	Agent Tank		TOX-8	1E-4			10
72	Ventilation System	TOX	Agent Tank		TOX-2	1E-4			10
73	Ventilation System	TOX	Agent Tank		TOX-3	1E-4			10
74	Ventilation System	TOX	Agent Tank		TOX-5	1E-4			10
75	Ventilation System	MPB	Bulk Container		MPB-3B	1E-4			10
76	Ventilation System	MPB	Bulk Container		MPB-2B	1E-4			10
77	Ventilation System	ECR	Mine	POMVC 047	ECR-2DM	1E-4			10
78	Ventilation System	ECR	Mine		ECR-3DM	1E-4			10
79	Ventilation System	ECR	Mine		ECR-1DM	1E-4			10
80	Ventilation System	ECR	Mine		ECR-4DM	1E-4			10
81	Ventilation System	MPB	Bulk Containers		MPB-5B	1E-4			10
82	Ventilation System	MPB	Projectile		MPB-2DP	1E-4			10
83	Ventilation System	ECR	Projectile		ECR-1DP	1E-4			10
84	Ventilation System	ECR	Projectile	POPAC 047	ECR-2DP	1E-4			10
85	Ventilation System	MPB	Projectile		MPB-1DP	1E-4			10
86	Ventilation System	ECR	Projectile	POPAC 048	ECR-3DP	1E-4			10
87	Ventilation System	MPB	Projectile		MPB-3DP	1E-4			10
88	Ventilation System	ECR	Projectile		ECR-4DP	1E-4			10
89	Ventilation System	ECR	Rocket		ECR-2DR	1E-4			10
90	Ventilation System	ECR	Rocket	PORAC 047	ECR-5DR	1E-4			10
91	Ventilation System	ECR	Rocket	PORAC 048	ECR-6DR	1E-4			10
92	Ventilation System	ECR	Rocket		ECR-7DR	1E-4			10
93	Ventilation System	ECR	Rocket		ECR-1DR	1E-4			10
94	Ventilation System	ECR	Rocket		ECR-3DR	1E-4			10
95	Ventilation System	BSA	Ton Container		BSA-2	1E-4			10
96	Ventilation System	ECV	Ton Container		ECV-1	1E-4			10
97	Furnace Ventilation	FR	Ton Container		???	1E-2			10
98	Air Compressors	IA			???	1E-4			10

representative of this situation. Given that this failure of administrative control affects their own safety (and assuming that 30% of all operators smoke), it is estimated that $1 \times 10^{-3} \times 3.3 \times 10^{-1} = 3.3 \times 10^{-4}$ is the probability of smoking initiating a fire.

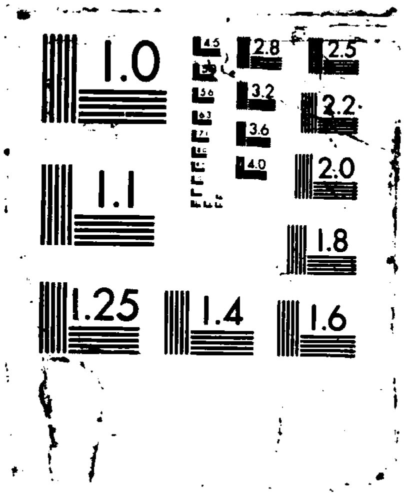
Operators or maintainers could cause sparks any time they handle a weapon or use metal tools, which they are likely to do in any area of the plant. Except for the UPA, some sort of upset would probably have to have occurred for them to be handling munitions or using tools. The likelihood of their causing sparks in such a case is the same as that of their dropping a munition during handling. The estimated probability of dropping a single munition when it is hand-carried by a two-man crew dressed in DPE was estimated as 6×10^{-4} in the HRA for handling scenarios as described in Chapter 8.

9.2.2.4.2. <u>Fire Suppression</u>. When a fire occurs in the UPA, the control room, the UPS, the IEP, the communications room, or the TOX, an automatic fire-suppression system should come on. If the automatic system fails to start, the operators can initiate it from the control room. He does this in response to an annunciator alarming on the panel dedicated to fire alarms (an annunciator there always indicates fire somewhere in the plant). There are probably several other annunciators alarming at the same time; we assumed six for this analysis. Item 6 from Table 20-23 (Ref. 9-26), 5×10^{-3}, was used to estimate the likelihood of the operator's failing to initiate the failed automatic fire-suppression system.

If the fire-suppression system still does not respond, or if the fire is in an area of the plant that has no automatic system, the next recourse for extinguishing the fire is to isolate the room where it is burning. The operators can do this by closing the exhaust dampers for the room in question. Again, they can do this from the control room. For this analysis, we assumed that the operators' training would emphasize room isolation as the best method of fire-fighting outside of the

AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO CA A W BARSELL ET AL. AUG 87 GA-C-18563 8/13

UNCLASSIFIED SAPEO-CDE-IS-87006 DAAA15-85-D-0022 F/G 15/6.3 NL

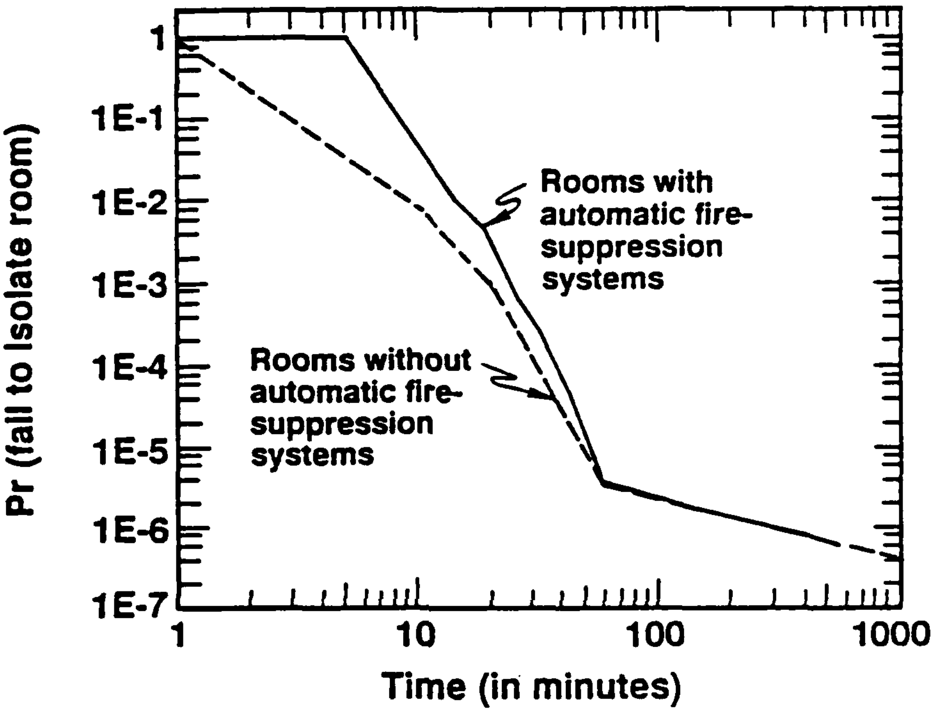

1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

use of automatic systems. Therefore, the problem is one of the operators' remembering that there is a viable solution to a fire.

The nominal diagnosis model from NUREG/CR-1278 (Ref. 9-26) was used as the basis to estimate the likelihood that the operators won't select room isolation. Since the "diagnosis" task here is fairly straightforward and since we have assumed that training will emphasize isolation as the action of choice, we used the lower bound of that curve to represent the case in which the fire is in a room without any automatic fire-suppression system.

If the fire does involve one of the rooms mentioned above, the operators will likely spend at least 5 min trying to start the failed automatic system. Since the diagnosis curve is time-based, 5 min of decision time is lost early in the accident. The modified curve accounting for this, along with the curve used for the rooms without fire-suppression systems, is shown in Fig. 9-1. The results of the analysis will show that the delay in diagnosing the need for isolation is more than compensated for by having an automatic system.

If the automatic fire-suppression system (if any) does not function and if room isolation is not achieved (or if it is not achieved in time), the operators' last resort is to enter the area with the fire and fight it with the hand-held fire extinguishers that are located throughout the plant. If it is an agent fire, if DPE protective clothing is necessary to enter the area, or if burstered munitions are in the area, it is assumed that the operators will not elect to try this option; they will not fight the fire at the site in any of these cases. If the fire is in an area they can enter wearing street clothes and masks and if burstered munitions are not present, it is estimated that there is a 5×10^{-2} probability that they will fail to try at-site fire fighting. This estimate is based on scientific judgment.



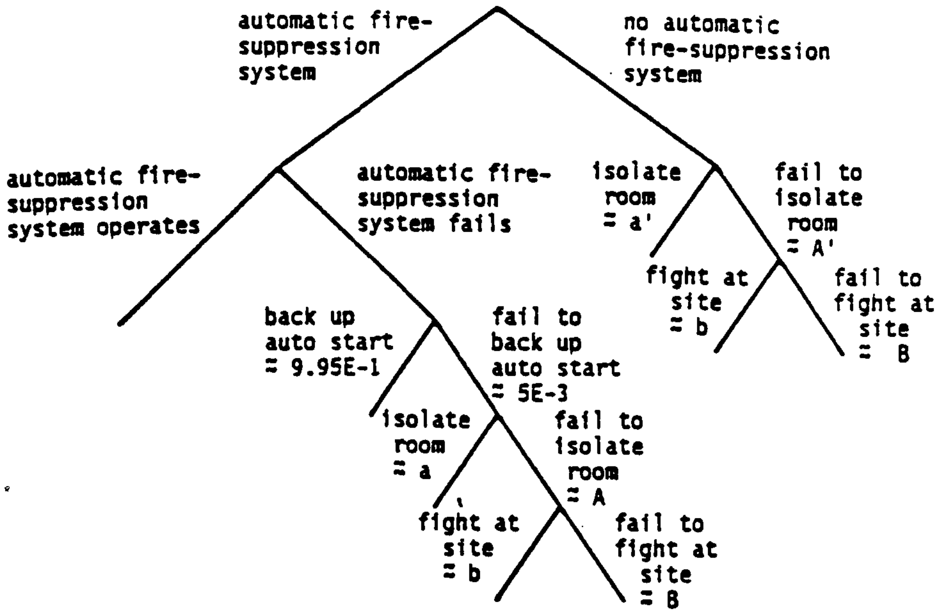
Time	Pr (fail to isolate by X mins) With System	Pr (fail to isolate by X mins) Without System
by 5 mins.	1.0	4E-2
by 10 mins.	4E-2	1E-2
by 15 mins.	1E-2	4E-3

Fig. 9-1. Probability of failure to isolate room by X min

For a complicated scenario such as this, THERP suggests the use of an HRA event tree. The HRA event tree for this fire-suppression model is shown in Fig. 9-2, and the results of quantifying it are shown in Table 9-12.

9.2.2.4.3. Conveyor Loading. In the UPA, operators in Level C protective clothing (masks worn) unload munitions and bulk containers from pallets and/or trucks and place them onto the conveyor system that then carries the munitions and containers through the process areas. Smaller munitions such as mines, projectiles, cartridges, and M55 rockets are lifted by hand (sometimes by two operators) and placed onto the conveyors. There are metering devices that ensure proper alignment of the rockets on the conveyor and allow only a single munition at a time to enter the ECV. When hand-loading the projectiles, operators could drop the munition in the UPA. The estimated probability of dropping a single munition when it is hand-carried by a two-man crew dressed in Level C protective clothing has been estimated as 3×10^{-4} in the HRA for handling scenarios.

The conveyor itself has 1/2-in. high guard rails that prevent a munition's falling off the conveyor. Even if the operators load the munition crookedly, the guard rails and the metering device will orient it properly as it passes into the ECV. The only other possible error involves their loading the munition backwards. Since we assume that the operators will usually pick up the same end of each munition (at least for a time), the likelihood of their standing in the wrong position--a necessary condition for loading the munitions backwards--is very low. It has been estimated to be an order of magnitude lower than the drop probability, or 3×10^{-5}. The likelihood that a munition is loaded improperly by the operators such that it could drop during loading or fall off the conveyor as a result of improper loading is the sum of these two error probabilities, or $3 \times 10^{-4} + 3 \times 10^{-5} = 3.3 \times 10$-4.



A = fail to isolate room having automatic suppression system

by 5 mins.	1.0
by 10 mins.	4E-2
by 15 mins.	1E-2

a = isolate room having automatic suppression system

by 5 mins.	0.0
by 10 mins.	9.6E-1
by 15 mins.	9.9E-1

A' = fail to isolate room not having automatic suppression system

by 5 mins.	4E-2
by 10 mins.	1E-2
by 15 mins.	4E-3

a' = isolate room not having automatic suppression system

by 5 mins.	9.6E-1
by 10 mins.	9.9E-1
by 15 mins.	9.96E-1

B = fail to fight fire at site when

agent fire, DPE, or burstered munitions	1.0
no agent fire, DPE, nor bursted munitions	5E-2

b = fight fire at site when

agent fire, DPE, or burstered munitions	0.0
no agent fire, DPE, nor burstered munitions	9.5E-1

Fig. 9-2. HRA event tree of fire suppression model

TABLE 9-12
THERP QUANTIFICATION OF FIRE-SUPPRESSION MODEL

Time After Onset of Fire (min)	Probability That Operators Fail to Suppress the Fire (DPE required or Burstered Munitions Present)			
	Agent Fire		No Agent Fire	
	Automatic Suppression System	No Automatic Suppression System	Automatic Suppression System	No Automatic Suppression System
5	5.0×10^{-3}	4.0×10^{-2}	2.5×10^{-4}	2.0×10^{-3}
10	2.0×10^{-4}	1.0×10^{-2}	1.0×10^{-5}	5.0×10^{-4}
15	5.0×10^{-6}	4.0×10^{-3}	2.5×10^{-6}	2.0×10^{-4}

Ton containers, spray tanks, and bombs are loaded onto the conveyor using a forklift lifting beam. The estimated probability of dropping a single bulk item when a two-man crew in Level C protective clothing use a forklift with a lifting beam was estimated as 1.5×10^{-5} in the HRA for handling scenarios. The only other credible errors are those of loading the containers crookedly (a no-cost error given the guard rails) or backwards. Backwards loading is most likely with a ton container since its exterior profile shows no obvious fore or aft indication (except for location of the plugs). Again, the operators have separate, assigned duties during loading. Since the ton containers should be guided by one operator while the other operator drives the forklift, the likelihood of its being improperly loaded is estimated to be an order of magnitude lower than the drop probability, or 1.5×10^{-6}. The likelihood that any kind of bulk container is loaded improperly by the operators is the sum of these two error probabilities, or $1 \times 10^{-5} + 1 \times 10^{-6} = 1.65 \times 10^{-5}$.

9.2.2.4.4. Munition Counting. When munitions are unloaded in the UPA, the packing material is sent to the Dunnage Incinerator (DUN). If a munition is left in the packing material (if it is not unpacked), it will be sent as-is to the DUN, also. The operators must keep track of the pallets and barrels passing through the UPA to ensure that they are emptied before being disposed of. All pallets are unloaded completely before beginning the next pallet-unloading operation. In other words, two pallets are never partially unloaded because of their being unpacked simultaneously. Since the pallet layers must be removed to access munitions on the next layer down, it is not likely that operators will miss a palletized, unpacked munition. Also, the pallet itself does not obscure the individual munitions from view even before it has been removed. The likelihood that an operator will fail to unpack a pallet completely and send the unpacked munition to the DUN along with the dismantled pallet is negligible.

Mines are packed three to a barrel; their fuzes are packed separately but in the same barrel. There are six barrels on a pallet. Once the pallet has been dismantled, the barrels themselves must be unpacked. The barrels are inverted inside a glove box one at a time, then lifted off of the mines and the packing material. Once the barrel has been emptied, it is used to hold the discarded packing material for the trip to the DUN. For a mine to enter the DUN along with the packing material, it would have to be placed in the barrel instead of on the conveyor. Munition accountability with respect to the number processed will be checked before the dunnage is disposed of; this provides a measure of recovery should this highly unlikely event occur. The probability of a mine being fed to the DUN along with its packing material is assumed to be negligible.

9.2.2.4.5. Tank Overfill. When draining a bulk-agent container, the agent is transferred to an agent tank in the Toxic Cubicle (TOX). When the agent tank's capacity is reached, the process-control system should automatically halt the transfer. If the high-level sensor on the tank fails or if some other failure occurs such that the transfer is not halted, the operator who initiated the transfer can halt it manually before the tank spills over.

It should be stated in the plant's administrative-control policies (and even in the process-control logic) that a bulk container should not be drained unless its entire contents can be accepted by a single agent tank. Of the two agent tanks in the TOX, the operators could have selected (and the process-control logic could have defaulted to allow) the wrong tank to receive the agent from a bulk container. If this wrong tank has insufficient capacity to accommodate the contents of the container, TOX tank level will approach and then exceed its maximum sometime during transfer. The probability of a selection error when dealing with displays with clearly delineated mimic lines is estimated to be 5×10^{-4} (Ref. 9-26, Table 20-9, item 1). Since this error has to occur in conjunction with a process-control failure (the probability of

which is estimated to be 1×10^{-3}), the likelihood that the wrong tank will be selected to receive the agent is 5×10^{-7}.

Assuming that agent is being transferred to a too-full tank, a sensor should halt the transfer at the tank's high-level setpoint. If the sensor fails, the operator (who should be monitoring the transfer intermittently) might notice the tank's high level and halt the transfer manually before a spill occurs. A typical transfer operation takes about 30 min; it is not assumed that the operator will watch the levels in the bulk container and the TOX tank for that whole period (although it is assumed that he will monitor both levels at some point since he initiated the transfer). Rather, it is assumed that he will initiate the transfer and then leave to complete other tasks while it is going on; it is also assumed that he will return to view the monitor screen periodically during the transfer to check its progress.

The estimated probability of his not noticing that the level of the TOX tank is dangerously high during the transfer operation is based on the estimated probability of an error made in reading quantitative information from an analog meter, 3×10^{-3} (Ref. 9-26, Table 20-10, item 1). The lower bound of 1×10^{-3} is used for this case to reflect better-quality reading characteristics associated with CRT analog displays. If the operator returns several times during the transfer to check the level of the TOX tank, the memory of his first reading will influence his perception of subsequent readings, so they were considered a perceptual unit. Both error probabilities are summed to estimate the total human-error contribution to this scenario. This means that $5 \times 10^{-7} + 1 \times 10^{-3} = 1 \times 10^{-3}$.

9.2.2.4.6. Sump Pump Operation. When there has been a spill in the TOX, the sump pump provides some level of mitigation. If the sump pump fails to operate following a spill, there is still a chance that the operators could start it manually from the control room. Since the spill in the TOX has already occurred when the sump pump fails, there

are probably several annunciators alarming when the sump pump alarm goes off. Assuming there are ten annunciators competing for the operator's attention, 5×10^{-2} (Ref. 9-26, Table 20-23, item 10) is the probability that he will fail to respond to the sump pump alarm.

9.2.2.4.7. Undrained Munition. There is some chance that an undrained ton container will reach the MPF, where it presents a considerable hazard. There are two points at which the operator might notice this and intervene to prevent its introduction into the MPF. The first of these is in the MPB as the container is being drained. The operator should have initiated the drain operation and should be watching for some indication that it is, in fact, taking place.

The second potential for operator intervention comes as the container leaves the BSA and is weighed before being transferred to the MPF. The operator should check the reading at the weigh station before allowing the container to continue to the MPF. The likelihood that the operator does not watch an operation that he is supposed to monitor on the CRT screen and/or the CCTV is assumed to be equivalent to his not following/using a set of written procedures. The error probability for his failing to monitor the screen(s) is 1×10^{-2}, taken from Table 20-6, item 3. This is used for his failing to monitor the drain operation in the MDB before the container is transported to the BSA and also for his failing to check the weight of the container as it leaves the BSA.

If the operator checks the container's weight, there is a chance that he will misread the weight on the CRT display. The probability of a misreading error when using a CART analog display is 1×10^{-3} (Ref. 9-26, Table 20-10, item 1, lower bound). The likelihood that the operator in neither case acts to prevent an undrained container's entering the MPF is calculated as $(1 \times 10^{-2} \times 1 \times 10^{-2}) + 1 \times 10^{-3} = 1.1 \times 10^{-3}$.

9.2.2.4.8. Ventilation System. Any time there is a ventilation system failure, there is some chance that the operators could effect recovery. For areas outside the furnace rooms, the operators should shut off the air supply fans within an hour of ventilation system failure. There is no direct indication that this is the needed action, so some diagnosis is involved. Using a standard diagnosis curve, the likelihood of their having failed to shut off the air supply fans by the end of an hour is estimated as 1×10^{-4} using Fig. 12-4 from NUREG/CR-1278 (Ref. 9-26).

9.2.2.4.9. Furnace Ventilation. For ventilation system failures involving the furnace rooms, the scenario is somewhat different. One train should be in service at all times. If that ventilation train fails, the operators can valve in an alternate train. This involves closing the dampers to the failed system, opening the dampers and headers to the alternate system, and starting up the alternate system. The primary ventilation system is assumed to fail at least 10 min following an initiator involving furnace shutdown; once it has failed, the operator has about 10 more minutes to complete the transfer to avoid serious consequences.

Since the ventilation system failure occurs 10 min after the furnace shutdown, the two failures do not occur "closely in time". Moreover, different operators are dedicated to monitoring the furnace and the ventilation systems. Therefore, the first-event diagnosis model (Ref. 9-26, Table 20-3, item 1) was chosen to model this event. Since the furnace shutdown is likely to lead to ventilation system failure, the operators may expect to have to deal with that problem. Because of their expectation, the lower bound of the nominal diagnosis model value, or 1×10^{-2}, was used.

9.2.2.4.10. Air Compressors. Some sequences assumed a reduced capacity of the primary plant-air and instrument-air compressor because of a downstream blockage. Since the blockage does not involve the

compressor itself, no trouble alarm associated with it will sound. Instead, a low-pressure alarm for downstream will sound at some time, after which there is a 15-min period before reserve-air inventory is depleted.

The non-occurring trouble alarm would have been sufficient to cause automatic transfer to the standby compressor; since it did not alarm, the transfer must be initiated by an operator sometime in that 15-min interval. This depends on his noticing the low-pressure alarm since an operator's recognition of an annunciator means that he will respond to that annunciator. It is assumed that there would have been no other shutdowns (nor their associated alarms) for at least 15 min before the low-pressure alarm sounds, so the error estimate listed as item 1 in Table 20-23 (Ref. 9-26) was used.

9.3. REFERENCES

9-1. U.S. Army Office of the Program Executive Officer-Program Manager for Chemical Munitions, "Transportation of Chemical Agents and Munitions: A Concept Plan," Final Report by MITRE Corp., June 30, 1987.

9-2. Clarke, R. K., et al., "Severities of Transportation Accidents," SLA-74-001, Sandia National Laboratories, July 1976.

9-3. Federal Railroad Administration, "Accident/Incident Bulletin No. 151, Calendar Year 1982," Department of Transportation, June 1983.

9-4. Corps of Engineers (HND) R/M Data Base (Rep. No. 16), see IEEE Std. 500-1984, pages 1252 through 1254 and pages 1256 through 1259 (seven failure rate estimates).

9-5. Rossi, M. J., "Nonelectronic Parts Reliability Data," Report NPRD-3, prepared for Rome Air Development Center by IIT Research Institute, 1985.

9-6. "Nuclear Plant Reliability Data System NPRDS A02 and A03 Reports - Annual Reports of Cumulative System and Component Reliability for Period from July 1, 1974 through December 31, 1982," Reports NPRD A02/A03, prepared for the Institute of Nuclear Power Operations by Southwest Research Institute, October 1983.

9-7. "SRS Data Bank," National Centre of System Reliability, UKAEA, Culchetb, Warrington, WA34NE.

9-8. "Risk Analysis of Six Potentially Hazardous Industrial Objects in the Rijnmond Area, A Pilot Study," a Report to the Rijnmond Public Authority, D. Reidel Publishing Company, Holland, 1982.

9-9. "Reactor Safety Study, An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," Report No. WASH-1400, U.S. Nuclear Regulatory Commission, October 1975.

9-10. IEEE Guide to the Collection and Presentation of Electrical, Electronic, Sensing Equipment, and Mechanical Equipment Reliability Data for Nuclear-Power Generating Station, IEEE Std. 500-1984, Wiley-Interscience, 1983.

9-11. Meachum, T. R. and C. L. Atwood, "Common Cause Fault Rates for Instrumentation and Control Assemblies: Estimates Based on Licensee Event Reports at U.S. Commercial Nuclear Power Plants, 1976-1981," Report No. NUREG/CR-3289 (EGG-2258), prepared for the U.S. Nuclear Regulatory Commission by EG&G Idaho, Inc., May 1983.

9-12. Humphreys, M., "Application of Reliability Techniques to Instrumentation Systems," U.K. Atomic Energy Authority Report No. SRS/GR/55, April 1982.

9-13. Wright, R.I., "Microprocessor Hardware Reliability," U.K. Atomic Energy Authority, Report No. SRS/GR/60, October 1982.

9-14. Oswald, A. J., et al., "Generic Data Base for Data and Models Chapter of the National Reliability Evaluation Program (NREP)," Report No. EGG-EA-5887, prepared for the U.S. Nuclear Regulatory Commission by EG&G Idaho, Inc., June 1982.

9-15. Kolb, G. J., et al., "Interim Reliability Evaluation Program: Analyses of the Arkansas Nuclear One - Unit 1 Nuclear Power Plant," NUREG/CR-2787, U.S. Nuclear Regulatory Commission, June 1982.

9-16. Montague, D. F., and H. M. Paula, "A Survey of B-Factor and C-Factor Applications," JBFA-LR-104-84, JBF Associates, Inc., September 1984.

9-17. NUREG/CR-4780 (to be published).

9-18. Paula, H. M. and D. J. Campbell, "Analyses of Dependent Failure Events and Failure Events Caused by Harsh Environmental Conditions," Report No. JBFA-LR-111-85, prepared for the U.S. Nuclear Regulatory Commission by JBF Associates Inc., August 1985.

9-19. Baranowski, P. N., et al., "A Probabilistic Safety Analysis of DC Power Supply Requirements for Nuclear Power Plants, U.S. Nuclear Regulatory Commission Report No. NUREG-0666, April 1981.

9-20. Atwood, C. L., "Common Cause Fault Rates for Pumps: Estimates Based on Licensee Event Reports at U.S. Commercial Nuclear Power Plants, January 1, 1972 through September 30, 1980, Report No. NUREG/CR-2098 (EGG-EA-5289) prepared for the U.S. Nuclear Regulatory Commission by EG&G Idaho, Inc., February 1983.

9-21. Stevenson, J. A. and C. L. Atwood, "Common Cause Fault Rates for Valves: Estimates Based on Licensee Event Reports at U.S. Commercial Nuclear Power Plants, 1976-1980," Report No. NUREG/CR-2770 (EGG-EA-5485), prepared for the U.S. Nuclear Regulatory Commission by EG&G Idaho, Inc., February 1983.

9-22. Battle, R. E., Collection and Evaluation of Complete and Partial Losses of Off-Site Power at Nuclear Power Plants," Report NUREG/CR-3992 (ORNL/TM-9384), prepared for the U.S. Nuclear Regulatory Commission by Oak Ridge National Laboratory, February 1985.

9-23. "Plant Risk Status Information Management Systems (PRISIM) Version 2.0 User's Guide," Report No. JBFA-108-86, prepared for the U.S. Nuclear Regulatory Commission by JBF Associates, Inc., October 1986.

9-24. Carlson, D. D., et al., "Interim Reliability Evaluation Program Procedures Guide," Report No. NUREG/CR-2728 (SAND 82-1100), prepared for the U.S. Nuclear Regulatory Commission by Sandia National Laboratories, January 1983.

9-25. "Military Handbook: Reliability Prediction of Electronic Equipment," Rome Air Development Center, Griffith AFB, NY, MIL-HDBK-217C, April 1979.

9-26. "Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications," NUREG/CR-1278, U.S. Nuclear Regulatory Commission, August 1983.

9-27. "Probabilities of Selected Hazards in Disposition of M55 Rockets," M55-CS-02, USATHAMA, September 22, 1985.

9-28. Fischer, L. E., et al., "Shipping Container Response to Severe Highway and Railway Accident Conditions," NUREG/CR-4829, Vols. 1 and 2, Lawrence Livermore National Laboratory, February 1987.

10. AGENT RELEASE CHARACTERIZATION

Section 10.1 describes the approach used in this study for analyzing the agent release for the various accident conditions. Application of the approach to the accident sequences analyzed in the collocation disposal phases is discussed in Section 10.2.

The consequences of an agent release event are strongly dependent on agent type, amount of agent release, and the mode and duration of the release. Agent dispersion and subsequent effects will be calculated in a separate study using a computer program called D2PC that embodies an analytical model for calculating agent dispersion under different meteorological conditions. Feedback from these consequence calculations helped to guide the release characterization.

10.1. RELEASE ANALYSIS APPROACH AND BASES

10.1.1. Approach

The approach formulaton was aided by a systematic review of the mechanisms involved in expelling agent from its normal confinement. The first result of the systematic review was to divide the accident sequences into two groups: (1) those that occur while the agent is still present in the munitions and (2) those that occur after the agent has been separated from the munition. The first group is associated with the activities of storage, handling, and transportation, while the latter group is associated with the activities of plant operations. For the latter group, the analyses performed by Arthur D. Little for the M55 rockets (Refs. 10-1 through 10-5) were partially applicable, and similar assumptions as appropriate were made for this analysis. Additional calculations were performed in this study to determine the quantity of

agent released to the environment for plant operation accidents involving munitions other than the M55 rockets.

For the accident scenarios that involve agent still confined in the munition, the agent release is dependent on the munition's mechanical and thermal failure thresholds, and the behavior of the explosives and propellants during the accident scenarios. These are discussed in the following sections. Once it was determined that the agent could be released from its normal confinement, calculations were performed to determine the amount of agent released and the possible paths by which the agent could enter the atmosphere.

10.1.2. Mechanical Failure Release

Munition failures result when sufficient forces are generated during accidents. A discussion of the munition failure thresholds is given in Appendix F. The failure thresholds of interest are:

1. Mechanical failure of the agent containment due to impact, crush or puncture.
2. Detonations initiated by impact or fire.
3. Thermally induced hydraulic rupture of the agent containment.

10.1.2.1. Impact Failure. The threshold for impact failure is given in terms of velocity of impact against a nonyielding object, or the equivalent drop height. When the impact failure threshold is reached, it is assumed that the onset of failure begins. In the case of an accident involving more than one munition, e.g., a pallet drop or a truck collision, every munition does not experience the effect of impacting a nonyielding surface. At the threshold point, it is assumed that at least one munition has experienced failure. It was further assumed that the number of munitions that experience failure is a function of the kinetic energy involved in the accident. For munitions in a transportation

package, the failure threshold for both the package and the munition must be exceeded in order to cause an agent release.

The impact velocity required to initiate failure varies from 35 mph for rockets (drop height of 40 ft) to 50 mph for projectiles (drop height of 120 ft). The expected impact velocity (or drop height) for some accidents is:

Accident Type	Impact Velocity of Drop Height
Pallet drop during handling	6 ft
Forklift collision	5 mph
Truck accident onsite	10 to 25 mph (administrative control is assumed to be 10 mph)
Train accident offiste	50 mph
Aircraft crash	>200 mph

In view of the above, failure due to impact is not considered to be a significant contribution for handling accidents and onsite truck transportation accidents, i.e., other failure mechanisms dominate.

10.1.2.2. Crush Failure. Crush forces are static forces completely independent of velocity. Crush forces may arise from a vehicle overturn or from a building collapse due to an earthquake.

Crush thresholds are defined for a single munition for a pallet of munitions and for the transportation package when transportion is involved. When the crush threshold for pallets is exceeded, it was conservatively assumed that all munitions in the pallet will fail.

A linear relationship for the number of units that would fail due to crush was assumed as follows:

$$n = \frac{F}{F_o} \quad , \qquad (10\text{-}1)$$

where F = crush force available in the accident,

F_o = crush force threshold for the palletized munition.

At n = 1, all the munitions in one pallet have failed. The available force in an accident can be the weight of a vehicle, the weight of a building collapse, or the weight of any large object that can fall on the munitions. For those accidents involving a transportation package, the crush force available must exceed the threshold for failing both the package and the munition.

The accident scenarios that are capable of generating forces sufficiently high to produce crush involve transportation and storage where many pallets may be involved in the accident. Thus, it is possible that more than one pallet can fail. For example, the crush threshold for a rocket pallet containing 15 rockets is 43,400 lb. If the weight of an object is 100,000 lb, Eq. 10-1 predicts a failure quantity of 2.3. This corresponds to 2.3 pallets, or about 34 rockets being crushed. If the available crush force is less than the failure threshold for a single munition, then naturally, no munitions fail.

Equation 10-1 is conservative because it assumes that the total available load arising from an accident is concentrated in the most efficient way to crush the munitions. If the load was uniformly distributed over many pallets, fewer or no failures would occur.

10.1.2.3. Puncture Failure. The puncture threshold is defined in terms of the ratio of velocity to radius of curvature assuming the munition (or pallet) impacts an unyielding slender object or probe. Generally, the failure threshold for puncture is the lowest of the three mechanical

failure thresholds. The number of failures that can occur in an accident is dependent on the number of probes present. If the puncture failure threshold is exceeded, it is assumed that one probe will fail one munition.

10.1.2.4. Liquid Spills and Evaporation. Once mechanical failure occurs, the munition agent inventory may be able to spill out on the ground or water. For fork tine punctures, the puncture is assumed to consist of a 3-in. diameter hole just below the munition centerline. The amount and time of spill is calculated to be that which can drain by gravity out of the hole. Impact, crush and probe punctures are assumed to result in the spill of the entire munitions inventory.

If the spill occurs outdoors, during handling or transport, the release analysis ends with the determination of the type and mass of liquid agent spilled and type of surface where the spill occurs. This information is sufficient input for calculation of atmospheric dispersion by the D2PC computer program. All liquid spills during handling or ground transport are assumed to occur on a hard, flat impervious surface such as level concrete or asphalt. The evaporation of the spill is calculated by the D2PC program by calculating the maximum puddle area and the corresponding evaporate rate.

If the spill occurs to the surface of water, it is expected, based on agent density and solubility characteristics, to mix well with water or sink (depending on agent type). However, for conservatism, 5% is assumed to remain on the surface and be available for evaporation. If the release occurs underwater (e.g., after ship sinking), no agent becomes available at the surface.

If the spill occurs indoors, the release analysis in this report extends to the time dependent rates of evaporation. In general, the D2PC program was applied to calculate the evaporation rate based on the type and mass of agent spill and considering any confinement of the

liquid puddle or pool. The D2PC general equation for evaporation of a spill over a floor area corresponding to a liquid pool depth of 1/32 in. relates the time t to evaporate the entire spill inventory M (pounds) in terms of a power function of M and two coefficients a and b. The equation is

$$t = aM^b \quad , \tag{10-2}$$

where t = time in thousands of minutes,
a, b = constant for agent GB ($a = 0.79$, $b = 0.253$),
a, b = functions of M for agents H and VX.

The area (ft^2) corresponding to the spill M (lb) and pool thickness 1/32 in. is 5.91 times M. For restricted pool areas, the equation must be modified. This equation and coefficients a and b are based on data from the Army derived from the computer program D2PC output.

For a given accident sequence the spill will generally not evaporate to completion because human intervention will mitigate the spill by covering it with foam or some other means. In such a case, an evaporation rate is calculated and applied until the time estimated for mitigation or cleanup of the spill.

From Eq. 10-2, the hourly evaporation rate is

$$m_{ev} = \frac{1}{a} M^{1-b} \frac{60 \text{ min}}{10^3 \text{ min}} \quad , \tag{10-3}$$

where m_{ev} has units of lb/h. This equation applies whenever the 1/32-in. deep spill pool area, which from the agent density is about 6 ft^2 for each lb of spill, is smaller than the actual confined pool

area (floor or sump). Some buildings contain floors which slope to sumps, as in the following:

Building Area	Sump Size (ft)
UPA	2 x 2 x 2
TOX cubicle	4 x 5 x 3.5
MHI	2 x 3 x 4
Warehouse	None
Storage igloo	None

Where a sump is present, the following procedure is used to calculate evaporation. Initially, the spill is assumed to wet the entire sloped floor area. Thus, Eq. 10-3 issued for a 10 min time period without modification for pool area, unless the 1/32-in. deep pool area is larger than the actual floor area. Modification consists of limiting M in Eq. 10-3 to the mass of a 1/32-in. layer of agent over the actual floor area. After 10 min, the evaporation rate is assumed to be limited by the sump horizontal cross sectional area until the assumed mitigation/cleanup time when it drops to zero. Such limitation amounts to modifying M in Eq. 10-3 to the mass of a 1/32-in. layer in the sump.

A special case is the spill of a ton container in the MDB where the UPA sumps are too small to hold the entire inventory. In this case the overflow area is calculated based on the volume of agent in a TC and the floor slope (1/4 in. rise per linear foot).

10.1.3. Detonations

The burstered munitions incorporate proven design features to preclude accidental detonation during routine handling and transportation. The impact threshold for initiating detonation, approximately 160 mph (see discussion in Appendix F), is well above the potential impact velocity for all accidents except an aircraft crash. When a munition

is subjected to an impact velocity greater than the detonation threshold velocity, there is still a low probability of detonation, but it is possible. Data does not exist to develop a meaningful relationship for predicting the number of detonations that could occur given an aircraft crash into a munitions storage area or transport vehicle. This rationale is that, given a stack of munitions pallets in storage or in a transport vehicle, the munitions in the first row would absorb most of the impact energy. These munitions could detonate. The others would then be subjected to the energy of the detonations, as well as part of the energy of the aircraft crash. It is known that the detonations do not propagate, but it is assumed that many of them would rupture. This logic was applied to all the aircraft crash scenarios and a general result was reached. The conservative estimate is that:

1. Fifteen percent of the munitions involved in the crash detonate.

2. Seventy percent of the rupture and release their agent content.

3. Fifteen percent are scattered but remain intact.

For impacts of burstered munitions in pallets, if a single munition detonation occurs it is assumed to rupture each surrounding munition in the pallet. A centrally located munition, which has the largest number of surrounding units, is conservatively assumed to be the one which detonates, even though it is less likely to detonate at this location than at the end. For projectiles, cartridges, and mortars, the number of adjacent munitions ruptured is five.

For rockets and mines only, the detonation of more than one munition was calculated to be credible for certain pallet impacts. In such

cases, two rockets detonate, rupturing 13 adjacent rockets. Or, three mines detonate rupturing 15 adjacent munitions.

10.1.4. Fire Release

Munitions subject to fire can fail due to thermally initiated detonations or due to hydraulic rupture. It is assumed that fires in direct contact with burstered munitions will be left unattended and allowed to burn until all combustible materials are consumed. Thus, bursters will detonate. Some neighboring munitions will fail due to the detonation. The failed munitions will spill combustible agent which will further fuel the fire. The fire will spread, leading to more detonations, and so on.

Tests at GA on 4.2-in. mortar projectiles and 8-in. projectiles showed that a detonation of a munition in a close packed array will cause the munitions adjacent to the detonated munition to break and spill their agent (Ref. 10-6). Other munitions not in direct view of the detonated munition were disheveled, but remained intact. Thus, one detonation is not sufficient to break all the munitions involved in the accident. A chain reaction must take place. The bursters in the neighboring munitions broken by a detonation will be subjected to more rapid heating than those of an intact munition. These bursters will detonate at a critical temperature, but it is assumed that detonation of a drained munition will not contribute to the agent release.

Based on the test results described above, it is inferred that all munitions in direct view of a munition detonation would be broken. In a rectangular array, typical for the munition storage configurations, this results in an agent release fraction of 1/9 due to detonation and 8/9 as a liquid spill. An irregular array, such as would exist after the first detonation, could result in a larger release fraction due to detonations. Therefore, it is assumed that 25% of the agent release is due to detonations for scenarios involving fire and detonations.

It is assumed that fires involving nonburstered munitions will always be fought. However, when an accident involves a large fire, the first priority may be to contain the fire and prevent its spreading into unaffected areas. For conservatism, a large fire involving nonburstered munitions was treated as in the case for burstered munitions, i.e., all combustible materials involved in the accident are consumed. Whether burstered or nonburstered munitions are involved, large fires were assumed to be confined to one building, one railcar, or one truck, as appropriate.

Agent that is burned is basically destroyed, but the destruction is usually incomplete. A previous analysis (Ref. 10-7) indicated that the recovery of undecomposed agent from fires is 2.5% for GB and 0.2% for VX. The analysis was based on tests at Dugway Proving Ground (Refs. 10-8 and 10-9) in which a mock-up igloo with 11 pallets of rockets containing GB was allowed to burn to completion. The unburned GB vapor was measured by a grid of detectors surrounding the fire at 30 m distance and extending 30 m high. Actual test measurements were made for GB, and the results for VX were derived by extrapolation based on the boiling temperature, thermal decomposition temperature and volatility of VX relative to GB.

Although the above references provide a quantitative data point on the behavior of agent in a large fire involving an igloo or a transport vehicle, there are several reasons to increase the predicted agent release fraction for fires. These are:

1. The analytical procedure for detecting agent during the test yielded small quantities of agent distributed over a large number of detectors. The samples were analyzed by the dianisidine-peroxide method. The sensitivity of these measurements is expected to be marginal considering the short time available for sampling the gas cloud as it passed through

the detection grid. Therefore, it is possible that a significant amount of agent vapor was not detected during the test.

2. The rockets contain a large amount of propellant, which in turn contains its own oxidizer. The propellant burns very quickly and tends to produce a hot fire, even when the fire is limited by the amount of oxygen present. Fires involving other munitions may burn slower and at a lower temperature, which would promote a higher fraction of undestroyed agent.

3. In one simulated test of an igloo fire (Ref. 10-9) four rockets were launched out of the igloo. One of them traveled 1300 ft away from the igloo. None of them detonated upon impact, but they all broke open and spilled agent onto the ground. When one adds the liquid spill of the four rockets that escaped from the igloo to the 2-1/2% agent vapor recovered, the total agent release from the event is 4.9%.

4. The analytical extrapolation to determine the recovery fraction for VX is not documented. Further, the uncertainty of an extrapolation in a complex thermal-chemical rate process is considered to be large. Although the chemical properties of VX and GB suggest that the recovery fraction for VX should be much less than GB, the conclusion that the recovery of VX would be 6% times the recovery of GB as stated in Ref. 10-9 is viewed with skepticism. Therefore, a more conservative value of 25% was assumed for the recovery factor of VX versus GB. Similarly, the chemical properties of HD suggest that an analytical extrapolation for the recovery of HD would also be less than GB, but greater than VX. Therefore, a value of 50% was assumed for the recovery factor of HD versus GB.

In view of the above discussion, the release fraction for unburned agent GB vapor in all fire scenarios was assumed to be 10%. This provides a factor of two over the 4.9% combined liquid plus vapor measured in the test to allow for uncertainties in the test measurements and uncertainties in the liquid agent that escapes the fire. The corresponding release fractions for HD and VX are assumed to be 5% and 2-1/2%, respectively. These release fractions are not considered as over conservatism. The main conservatism arises from the assumption that all the agent inventory is involved in the fire, and no credit is taken for the possibility that the fire might be extinguished before all combustible materials are consumed.

10.1.5. Release Duration

The accident durations assumed for this risk analysis were chosen to conservatively define a time for terminating most accidents identified in this analysis. In the scenarios involving liquid spills, the accident is terminated when the decontamination team has successfully terminated evaporation of agent vapor into the atmosphere. Army experience in handling and moving chemical munitions indicates that may of the agent spills could be cleaned up much quicker than the times assumed herein. However, since many accidents are rate events and have not occurred in the Army experience to date, conservative times for the accident durations have been applied.

The agent release for an evaporative spill is directly proportional to the release duration. Therefore, to be conservative, the release durations were estimated on the high side. The release durations assumed are:

1. For agent spills occurring during handling or demilitarization operations caused by human or equipment malfunction, the release duration was assumed to be 1 h.

2. For agent spills involving human or mechanical error during onsite transportation, it was assumed that the accident could not be terminated as quickly as the above. Therefore, the release duration was assumed to be 2 h.

3. For agent release in the MDB following an accidental detonation outside the ECR, but with no fire, the release duration was assumed to be 2 h.

4. For agent spills arising from an aircraft crash with no fire, the release duration was assumed to be 4 h.

5. For agent spills occurring during offsite transportation, it was assumed that an additional increase in decontamination time is necessary because the evaporation source may be less accessible. The accident duration for these accidents was assumed to be 6 h.

6. For severe external events, e.g., earthquake, tornado, airplane crash, the evaporation time was assumed to be 6 h.

Table 10-1 lists the times assumed for agent release for the accident scenarios involving fire and/or detonations. Plant operations accident scenarios are not included in the table because these accidents are mitigated by engineered safeguard features and are not covered by the discussion that follows.

The approach to deriving the assumed release durations was to group the accident scenarios with fire or detonations into sets with similar characteristics, then estimate a release time ranging from 10 min to 1 h. For accidents involving a large fire, it was assumed that all of the agent present ultimately becomes consumed or released as vapor. The conservative approach for these cases is to assume a shorter duration than expected because a given release to the atmosphere is more lethal

TABLE 10-1
AGENT RELEASE DURATION FOR ACCIDENTS INVOLVING FIRE AND DETONATION

Event	Agent Release Duration (min)	Type of Event
Fire only - no detonations	10	Handling vehicle collision
	60	Aircraft crash, truck collision/overturn, meteorite strike, earthquake
	120	Train derailment, ship accident
Fire with detonation	20	Aircraft crash, truck collision, earthquake, train derailment, ship accident
	60	Meteorite strike
Detonations only	Instantaneous	Aircraft crash

when distributed over a shorter time interval. Factors which influence the choice of time periods are discussed below.

There are three possible combinations of scenarios involving fire and/or detonations:

1. Detonations only.
2. Fire and detonations.
3. Fire only.

10.1.5.1. Detonations Only. The scenarios that fall into this category involve a high velocity impact, such as an aircraft crash, or spurious detonation arising from undue forces that are part of the accident scenario, e.g., dropping a pallet. It is known that the detonations do not propagate. Therefore, the release from detonations is assumed to occur instantaneously.

10.1.5.2. Fire and Detonations. These events are associated with storage and transportation accidents. For some events, there is a source of external fuel, e.g., an airplane crash or fuel from a locomotive or truck. In these scenarios, the detonations are propagated by the fire, and concurrently the detonations allow additional munition failures that further fuel the fire. The overall result is a violent conflagration. The total duration of the accident may be an hour or more; however, for conservatism, the duration of the agent release is assumed to be 20 min. The scenarios not included in the 20-min assumption involve a meteorite strike into a storage igloo or into a temporary storage area. In this case, there is no source of external fuel, although the scenario does assume that fire is initiated, and detonations are propagated by the fire until all combustible materials are consumed. Because the meteorite fire starts out relatively localized and without external fuel, the release duration for the meteorite strike is assumed to be 1 h.

10.1.5.3. Fire Only. Events involving fire only occur in some handling, storage, and transportation accidents. For events associated with onsite handling the amount of agent involved in the fire is relatively small. The exposed agent is allowed to burn to completion, and the release duration is assumed to be 10 min. The accidents in this group associated with transportation involve a large source of external fuel, e.g., an airplane crash or a locomotive. In addition, these events involve large quantities of agent, but they do not involve burstered munitions. Therefore, these accidents present a less difficult situation to control than the corresponding case when burstered munitions are present. The agent release duration for these events was assumed to be 1 h.

10.2. APPLICATION TO ACCIDENT SEQUENCES

This section illustrates the application of the release methodology to determine agent releases for the specific accident sequences for each phase of the demilitarization process. It is not intended to encompass all sequences. Appendix I presents the agent releases for all sequences. Details of all agent release calculations are contained in the supporting calculations, Ref. 10-10.

10.2.1. Handling

The procedure for analyzing agent releases during handling accidents was to first group the accident sequences according to agent release conditions or types of release. For example, there were a number of sequences resulting in liquid spill outdoors (HC5, HC7, CH10, HF1, HF7, and HC8). Table 10-2 shows the grouping results for all handling sequences. There were the following types of releases to be assessed:

1. Single munition rupture and spill outdoors.
2. Single munition rupture and evaporation indoors (in MDB, MHI, LPF, or storage igloo) or inside the package.
3. Burning of ruptured single munition spill outdoors.
4. Impact detonation of single munitions indoors.
5. Impact detonation and spill of munitions outdoors.
6. Impact detonation and spill of munitions indoors.
7. Fire and thermal detonation of munitions.

The agent inventory data for onsite and offsite transport containers is summarized in Table 10-3. Indoor spills are assumed to be mitigated within 1 h, so that evaporation lasts for that long. Failure

TABLE 10-2
GROUPING OF HANDLING SEQUENCES ACCORDING TO
AGENT RELEASE CHARACTERISTICS

Type of Release	Single Munitions Fails	Multiple Munitions In Pallet Or Containers Involved[a]
Puncture/crash		
Liquid spill		
Outdoors[b]	HC5, HC7, HC8, HC10, HF1, HF7	None
Evaporation		
In MDB	HC32, HF2, HF8, HF9, HF10	None
In MHI or LPF	HC13, CH16, HC17, HC18, CH19, HC21	None
In package	HC14, HF4	None
In storage igloo	HC1, HC3, HC4	None
Burning of agent spill		
Outdoors	HC2, HC6, HC9, HC20, HF3	None
Impact detonation and spill (if more than one) (no fire)		
Outdoors[b]	None	HC22, HC23, HC24, HC25, HF11, HF14
Indoors	HC28, HC30, HF12	HC11, HC12, HC29, HC31, HF13
Fire and thermal detonation	None	HC26, HC27[a], HF5

[a]HC27 involves inventory of offsite container: others involve one pallet.

[b]Outdoor spill release given in pounds of liquid, evaporation calculated by Mitre.

TABLE 10-3
INVENTORY DATA FOR ONSITE AND OFFSITE TRANSPORT CONTAINERS

Munition/Agent Type	Munition Inventory (lb)	No. Munitions Per Pallet or ONC	No. Pallets Per OFC
Bomb			
GB	220.0	2	6
Mortar			
H	6.0	48	4
105 cartridge			
GB	1.6	24	12
H	3.2	24	12
Ton container			
GB	1500.0	1	2
H	1700.0	1	2
VX	1600.0	1	2
Mine			
VX	10.5	36	3
155 projectile			
GB	6.5	8	15
H	11.7	8	15
VX	6.0	8	15
8-in. projectile			
GB	14.5	6	10
VX	14.5	6	10
Rocket			
GB	10.7	15	4
VX	10.0	15	4
Spray tank			
VX	1356.0	1	1

of the building ventilation system is a part of the definition of these sequences. The results for each of the above types of releases are summarized in Table 10-4.

10.2.2. Warehouse Storage Release During Earthquakes

There are three sites with stored, nonburstered munitions in warehouses. These are:

1. UMDA - ton containers with agent HD stored in two warehouses.

2. NAAP - ton containers with agent VX stored in one warehouse.

3. TEAD - spray tanks with agent VX stored in two warehouses.

Only spray tanks and ton containers are stored in warehouses, none of which contain agent GB. Based on their impact characteristics, the ton containers are predicted to be able to be crushed or breached by the kinetic energy of a falling I-beam if the warehouse structure is damaged. Each I-beam has sufficient energy to crush one ton container but not two. Thus, the maximum number of ton containers crushed per warehouse is five, since there are that many I-beams in the warehouse roof. For similar reasons, the maximum number punctured is taken to be five per warehouse.

Spray tanks are stored in overpacks and, based on structural calculations, are not expected to be breached by the falling I-beams. Consequently, the mechanical breaching of spray tanks due to an earthquake is not considered a credible event. If a fire lasts beyond 30 min, spray tanks may fail due to the unsuppressed fire. Thus, for spray tanks, only one type of release is considered, namely burning of one or two warehouse inventories due to fire beyond 30 min. The release

TABLE 10-4
AGENT RELEASES (POUNDS) FOR HANDLING SEQUENCES

Sequences	Release Mechanism	No. Munitions	Bomb GB	4.2-in. Mortar H	105 mm Cartridge GB	105 mm Cartridge H	Ton Containers GB	Ton Containers H	Ton Containers VX
HC13, HC16, HC17, HC18,	10 min floor evaporation		0.71	2×10^{-4}	0.02	1×10^{-4}	1.07	4×10^{-3}	5×10^{-5}
HC19, HC20	Sump evaporation		0.07	3×10^{-4}	0.07	3×10^{-4}	0.65	3×10^{-4}	2×10^{-6}
(Spill in MHI, LPF)	Total evaporation	1	0.78	ϵ	ϵ	ϵ	1.72	ϵ	ϵ
HC2, HC6, HC9, HC20, HF3	Burn of spill	1	22	0.3	0.16	0.16	150	85	40
HC5, HC7, HC8, HC10, HF1, HF7	Outdoor spill(a) (pounds of liquid)	1	220	6.0	1.6	3.2	1500	1700	1600
HC11, HC12, HC29, HF13,	Detonation release	M	NA	1.50	0.40	0.80	NA	NA	NA
HC31	10 min floor evaporation	N	NA	1×10^{-3}	0.09	5×10^{-4}	NA	NA	NA
(Impact detonation)	Sump evaporation	N	NA	3×10^{-4}	0.07	3×10^{-4}	NA	NA	NA
	Total evaporation		NA	ϵ	0.16	ϵ	NA	NA	NA
HC14, HF4	Package evaporation	1	0.22	0.01	0.22	0.01	0.22	0.01	ϵ
HC28, HC30, HF12	Detonation release (no fire)	1	NA	1.50	0.40	0.80	NA	NA	NA
HC26, HF5	Detonation release	P	NA	72	9.6	19.2	NA	NA	NA
(1 pallet - thermal	Fire release	P	44	11	2.9	2.9	150	85	40
failure)	Total release		44	83	12.5	22.1	150	85	40
HC32, HF2, HF8, HF9, HF10	1 min evaporation inside MDB	1	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
HC22, HC23, HC24, HC25,	Impact detonation	M	NA	1.5	0.40	0.80	NA	NA	NA
HF11, HF14	Outdoor spill(a)	N	NA	30	8.0	16.0	NA	NA	NA
HC27	Detonation	C, X, P	NA	288	115	230	NA	NA	NA
(Offsite containers -	Fire release		264	44	35	35	300	170	80
thermal failure)	Total release		264	332	150	265	300	170	80
HC1, HC3, HC4 (Spill in storage igloo)	Floor evaporation (no sump)	1	4.26	ϵ	0.10	ϵ	6.40	ϵ	ϵ

TABLE 10-4 (Continued)

Sequences	Release Mechanism	Mine VX	155 mm Projectile GB	155 mm Projectile H	155 mm Projectile VX	8-in. Projectile GB	8-in. Projectile VX	Rocket GB	Rocket VX	ST VX
HC13, HC16, HC17,	10 min floor evaporation	3×10^{-6}	0.04	4×10^{-4}	1×10^{-6}	0.10	4×10^{-6}	0.07	3×10^{-6}	5×10^{-5}
HC18, HC19, HC20	Sump evapoartion	2×10^{-6}	0.07	3×10^{-4}	2×10^{-6}	0.07	2×10^{-6}	0.07	2×10^{-6}	2×10^{-6}
(Spill in MHI, LPF)	Total evaporation	ϵ	0.10	ϵ	ϵ	0.17	ϵ	0.14	ϵ	ϵ
HC2, HC6, HC9, HC20, HF3	Burn of spill	0.26	0.65	0.59	0.15	1.45	0.36	1.07	0.25	33.9
HC5, HC7, HC8, HC10, HF1, HF7	Outdoor spill[(a)]	10.5	6.5	11.7	6.0	14.5	14.5	10.7	10.0	1356
HC11, HC12, HC29,	Detonation release	7.88	1.63	2.93	1.50	3.63	3.63	5.35	5.0	NA
HF13, HC31	10 min floor evaporation	4×10^{-5}	0.04	4×10^{-4}	8×10^{-6}	0.10	4×10^{-6}	0.97	ϵ	NA
(Impact detona-	Sump evaporation	2×10^{-6}	0.07	3×10^{-4}	2×10^{-6}	0.07	2×10^{-6}	0.07	ϵ	NA
tion)	Total evaporation	ϵ	0.11	ϵ	ϵ	0.17	ϵ	1.04	ϵ	NA
HC14, HF4	Package evaporation	ϵ	0.22	0.01	ϵ	0.22	ϵ	0.22	ϵ	ϵ
HC28, HC30, HF12	Detonation release (no fire)	2.63	1.63	2.93	1.50	3.63	3.63	2.68	2.50	NA
HC26, HF6	Detonation release	95	13.0	23.4	12.0	21.8	21.8	40.1	37.5	NA
(1 pallet -	Fire release	7	3.9	3.5	0.9	6.5	1.6	16.1	2.8	34
thermal failure)	Total release	102	16.9	26.9	12.9	28.3	23.4	56.2	40.3	34
HC32, HF2, HF8, HF9, HF10	1 min evaporation inside MDB	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ	ϵ
HC22, HC23, HC24,	Impact detonation	7.88	1.63	293	1.50	3.63	3.63	5.35	5.0	NA
HC25, HF11, HF14	Outdoor spill[(a)]	2363	32.5	58.5	30.0	72.5	72.5	139	130	NA
HC27	Detonation	285	156	281	144	218	218	160	150	NA
(Offsite con-	Fire release	21	47	42	11	65	16	64	11	34
tainers - thermal failure)	Total release	306	203	323	155	283	234	224	161	34
HC1, HC3, HC4 (Spill in storage igloo)	Floor evaporation (no sump)	ϵ	0.24	ϵ	ϵ	0.56	ϵ	0.45	ϵ	ϵ

[(a)]*Notes: Outdoor spills are in terms of pound of liquid, C = number of pallets in offsite container, P = number of* munitions in pallet, ϵ = negligible, M = number of munitions detonating, N = number of munitions rupturing, NA = not applicable.

For mines, M = 3, N = 15, C = 3, and P = 36. For rockets, M = 2, N = 13, C = 4, and P=15. For all others, M = 1 and N=5.

fraction due to unburnt VX agent in this case is 2.5%, as in other accident scenarios.

For ton containers, three release types were considered:

1. Evaporation of agent spilled due to mechanical breach of one to five containers per warehouse.

2. Burning of agent spilled from breached containers.

3. Burning of the entire inventory in the warehouse, starting at 30 min.

The evaporative release rate is not limited by the floor area, which is tens of thousands of square feet per warehouse. Thus, the evaporative release rate, m_{ev}, is given by Eq. 10-2. For 10-ton containers with agent HD, M = 17,000 lb and a ≈ 451 and b ≈0.1. Thus, m_{ev} = 0.85 lb/h for 10 containers. *This rate of HD release is negligible.* Therefore, evaporative release of spilled HD from breached munitions is negligible. For agent VX, the maximum number of breached ton containers is five. In this limiting case, M = 8000 lb and a ≈ 49,000, b ≈ 0.12. Thus, m_{ev} = 0.003 lb/h for five breached containers. This rate of release is negligible.

The second and third types of releases involve burning of spilled agent from breached containers or burning of all ton containers due to a lack of fire suppression. For these cases, the release consists of the product of the appropriate inventory and the fire release fraction, F. Here, F = 0.025 for agent VX and F = 0.05 for agent HD, consistent with data described above. No credit is taken for agent vapor retention by the warehouse building, even if it is not structurally damaged by the earthquake, because it is not designed with a containment function.

As described in Section 5, an event tree was analyzed for the storage of ton containers at the UMDA and NAAP site warehouses. For the UMDA site, there were 17 release sequences with frequencies above 10^{-10}/yr. Table 10-5 lists these sequences along with the information pertinent to the release calculations. For sequences in which the burning or agent spilled from breached munitions is the only release mode, a range of release is given corresponding to the range of containers breached (1 to 5 or 2 to 10). For sequences in which the nonsuppressed fire ignites the entire warehouse inventory, the number of breached containers is unimportant.

Table 10-6 presents the corresponding release results for ton containers stored at the NAAP site. Only five sequences are important since there is only one warehouse at the site. The maximum masses of agent VX released from this site are seven times lower than maximum mass releases of agent HD from UMDA.

In the event tree for spray tanks stored at the TEAD site, there were six significant sequences as given in Table 10-7. Since no spray tanks are mechanically breached, the only consequence variable is whether the unsuppressed fire is not suppressed in one or both warehouses. The releases upon burning of the entire inventory at one or both warehouses are given in Table 10-7. They are 8 to 16 times lower than the maximum release of the same agent (VX) from the NAAP site.

10.2.3. Plant Operation Releases

10.2.3.1. Internal Events. The analysis of agent release due to in-plant accidents used the same calculation models discussed above when applicable. However, many plant operations involve accidents which occur after the munition has been punched and drained. The agent releases for these events are not dependent on the munition failure

TABLE 10-5
AGENT HD RELEASES FROM TON CONTAINERS STORED IN
UMDA WAREHOUSES DURING EARTHQUAKES[a]

Sequence ID	No. of Munitions Damaged	Spilled Munition Agent Burns	No. Warehouses In Which Entire Inventory Burns	Release To Atmopshere (lb)
SLKHF281	0	--	1	2.7×10^5
SLKHF282	0	--	2	5.4×10^5
SLKHC283	1-5	No	0	ϵ[b]
SLKHF284	1-5	Yes	1	2.7×10^5
SLKHF285	1-5	No	1	2.7×10^5
SLKHF286	1-5	Yes	2	5.4×10^5
SLKHC287	2-10	No	0	ϵ
SLKHF288	2-10	Yes	1	2.7×10^5
SLKHF289	2-10	Yes	2	5.4×10^5
SLKHC2810	1-5	No	0	ϵ
SLKHF2811	1-5	Yes	1	2.7×10^5
SLKHF2812	1-5	Yes	2	5.4×10^5
SLKHC2813	2-10	No	0	ϵ
SLKHF2814	2-10	Yes	1	2.7×10^5
SLKHF2815	2-10	Yes	2	5.4×10^5
SLKHC2816	2-10	No	0	ϵ
SLKHF2817	2-10	Yes	2	5.4×10^5

(a) Agent inventory = 5.4×10^6 lb per warehouse, assuming warehouse is full.

(b) ϵ = negligible (below 14 lb).

TABLE 10-6
AGENT VX RELEASES FROM NAAP WAREHOUSE TON CONTAINERS DURING EARTHQUAKES[a]

Sequence ID	No. of Munitions Damaged	Spilled Munition Agent Burns	Entire Warehouse Inventory Burns	Release To Atmosphere (lb)
SLKVF261	0	--	Yes	7.5×10^4
SLKVC262	1-5	No	No	ϵ[b]
SLKVF263	1-5	Yes	Yes	7.5×10^4
SLKVC264	1-5	No	No	ϵ
SLKVF265	1-5	Yes	Yes	7.5×10^4

[a] Warehouse inventory = 3×10^6 lb of VX, assuming warehouse is full.

[b] ϵ = negligible (below 0.3 lb).

TABLE 10-7
AGENT VX RELEASE FROM SPRAY TANKS STORED AT
TEAD WAREHOUSES DURING EARTHQUAKES[a]

Sequence ID	No. Warehouses In Which Entire Inventory Burns	Release To Atmosphere (lb)
SLSVF271	1	4.5×10^3
SLSVF272	2	9.0×10^3
SLSVF273	1	4.5×10^3
SLSVF274	2	9.0×10^3
SLSVF275	1	4.5×10^3
SLSVF276	2	9.0×10^3

[a] Agent inventory = 1.79×10^5 lb of VX, assuming warehouse is full.

models discussed above. The bases for agent releases for these events are as follows:

1. The evaporation rate for an indoor spill was calculated using the D2PC computer code (Ref. 10-11). Allowable surface area for evaporation was also calculated by D2PC for the first 10 min of the accident.

2. The munition inventory in the MHI is 24 h at the design process rate.

3. The munition inventory in the UPA is six packages.

4. The maximum agent inventory in the TOX and piping is 500 gal in the collection tank, 28 gal in the piping. This inventory is assumed to be present at the time of the accident.

10.2.3.2. Earthquake At MDB.

Burstered Munitions Release

There are two locations in the MDB where agent is present: the unpack area (UPA) and the TOX cubicle. The event trees for burstered munitions consider the potential scenarios leading to damage and agent release for one or more munitions in the UPA, damage and agent release of the TOX, or both. For the various seismic intensities, there were four sequences with significant frequencies of obtaining damage and

release, all involving fire in the MDB. For convenience these are summarized as follows:

Sequence	Earthquake Fails MDB	Munition Puncture	TOX	Fire Suppressed
P033	No	Not relevant	Intact	No
P025	Yes	Yes	Intact	Yes
P026	Yes	Yes	Intact	No
P029	Yes	No	Intact	No

Damage or failure of the MDB by the MDB by the earthquake is important since it allows release to atmosphere of any agent spill starting from time zero. Later, the MDB can fail due to nonsuppression of the fire. Other important intermediate events involve mechanical puncture and spill of a single munition during processing. Other munition failure modes such as early detonation of a single processed munition or puncture of a packed munition are screened out on the basis of low probability. Failure of the TOX, resulting in spill of the TOX agent inventory, due to the earthquake also is screened out on the basis of low probability. Both the mechanical failure mode for the TOX and the thermal failure of the TOX and piping is low probability. If the fire is not suppressed, it has the potential for failing the munitions in the UPA (entire inventory considered).

The above four sequences involve one or more combinations of two types of releases:

Sequences P026, P029, and P033 - Fire/detonation involving entire UPA inventory.

Sequence P025 - Evaporation release of one munition inventory, or a burn release of one munition inventory.

The algorithms for calculating each of these types of release are described below.

For the first type, the agent inventory in the UPA is six packages containing one munitions pallet per package. Thus, the total inventory is the inventory of a single munition, B (in pounds of agent), times the number of munitions per pallet, C, times six. Thus,

$$\text{UPA inventory} = 6 \times B \times C \quad . \tag{10-3}$$

Table 10-3 presents values of the single munitions inventory B and the total UPA inventory for the various burstered munitions.

The fire/detonation release is calculated by the equation,

$$\text{Fire/detonation release} = (\text{UPA}) \text{ inventory}) \ (0.25 + (0.75\ F) \quad , \tag{10-4}$$

where F is the release fraction due to incomplete burning. Here,

$$F = \begin{array}{l} 0.10 \text{ for agent GB} \\ 0.05 \text{ for agent H} \\ 0.025 \text{ for agent VX} \end{array} \quad . \tag{10-5}$$

These values represent the estimated unburned vapor release during a fire. Consistent with other initiating events, 0.25 is taken to be the release due to detonation of some of the bursters and spraying of agent. The fire release fraction is applied to the remaining 75% of the inventory.

The other type of release consists of indoor evaporation or burning of spilled agent from one munition released directly to the atmosphere (failed MDB). The burn release is simply the munition inventory times

the fire release fraction, F. The computer code D2PC is used to calculate the evaporative release. Values for the evaporative releases are presented in Table 10-8 for the various burstered munitions. Only agent GB evaporative released is significant since the releases for other agents are below threshold values for significant offsite consequences. These threshold values are 0.4 lb for agent GB, 0.3 lb for VX, and 14 lb for HD.

The evaporative releases are based on application of the evaporation data for a 6-h time period. This is the time estimated for mitigation or cleanup of the spill. For single burstered munition inventories, the 1/32-in. spill area is less than the VPA floor area. Since the floor area slopes to two 2 x 2 x 2 ft sumps, the following procedure is used.

Initially, the spill is assumed to wet the sloped floor area. Thus, the above equation is applied, without modifications due to any area restriction, for a selected 10-min time period. After that, the liquid is assumed to run down the shallow slope to one of the sumps, which is large enough to contain the entire burstered munition volume. Between 10 min and an estimated accident mitigation time of 6 h, the evaporation occurs at a rate dictated by the sump area of 4 ft^2. This rate is essentially that given by Eq. 10-2 with M corresponding to the mass of liquid in a 1/32-in. layer of the sump pool, rather than the entire munition inventory. The evaporative releases between 0 and 10 min and 10 min and 6 h are summed to get the total evaporation release.

Since it is not known from the event tree analysis whether the fire engulfs the sump, the approach in this analysis is to take the maximum of the fire release and the evaporative release. Table 10-8 shows these releases. Generally, the fire release dominates.

TABLE 10-8
AGENT INVENTORIES AND RELEASES

Munition Type	Agent Type	UPA Inventory (lb)	Agent Release (lb)					
			P026, P029, P033			P025		
			UPA Fire	Deton	Total	Evaporation	Burn	Net
Burstered Munitions								
Mortar	H	864	32	216	248	ϵ	0.30	0.30
Cartridge	GB	230	17	58	75	0.20	0.16	0.20
	H	461	17	115	132	ϵ	0.16	0.16
Mine	VX	2,268	43	567	610	ϵ	0.26	0.26
Projectile (155 mm)	GB	312	23	78	101	0.23	0.65	0.65
	H	562	21	141	162	ϵ	0.59	0.59
	VX	288	5	72	77	ϵ	0.15	0.15
Projectile (8 in.)	GB	522	39	131	170	0.27	0.15	0.27
	VX	522	10	131	141	ϵ	0.36	0.36
Rocket	GB	963	72	241	313	0.25	1.10	1.0
	VX	900	17	225	242	ϵ	0.25	0.25
Nonburstered Munitions								
Bomb	GB	2,640	264	NA	264	0.90	22	22
Ton container	GB	9,000	900	NA	900	5.60	150	150
	H	10,200	510	NA	510	ϵ	85	85
	VX	9,600	240	NA	240	ϵ	40	40
Spray tank	VX	8,136	203	NA	203	ϵ	34	34

Note: ϵ = negligible, NA = not applicable, P033 applies to burstered munitions only.

Table 10-8 presents the calculated releases for the significant accident sequences.

In sequence P033, the building remains intact from the earthquake, so no release occurs for the initial 10 min, regardless of whether a single munition spill occurs or not. The ensuing fire is not suppressed and the UPA inventory is ignited at 10 min, resulting in a fire/ detonation release.

In sequence P025, the MDB is damaged, so that the agent spill from the single munition puncture is released to atmosphere. The fire is suppressed before additional munitions are involved. Thus, the release consists of evaporation if the fire area is not coincident with the spill area or a burn release if the fire burns the spilled agent.

In sequences P026 and P029, the release during the initial 10 min is small (the same as the sequence P025). But since the fire is not suppressed, the UPA inventory is ignited and the total release becomes the (same as sequence P033).

Table 10-8 shows that significantly large releases (75 to 610 lb) occur for sequences P033, P026, and P029. Releases for sequence P025 are small.

Nonburstered Munitions Release

The event tree for nonburstered munitions contains three sequences with frequencies above the screening threshold of 10^{-10} per year. All

of these involve earthquake-induced damage to the MDB and fire. They are as follows:

Sequence	Munition Puncture	TOX	Fire Suppressed
P025	Yes	Intact	Yes
P026	Yes	Intact	No
P029	No	Intact	No

These sequences involve the same types of releases as for the burstered munitions with one exception. Nonsuppressed fire (lasting more than 10 min) for burstered munitions in the UPA involves both detonation and fire, while only fire is involved for nonburstered munitions. Also, the ignition time is 30 min for nonburstered munitions. Thus, the release algorithm is changed to:

$$\text{UPA release} = (\text{UPA inventory}) \times F \quad . \tag{10-6}$$

The evaporation algorithm is similar for burstered and nonburstered munitions. Inventory algorithms are the same.

Table 10-8 presents the inventories of agents in nonburstered munitions or in the TOX. The larger inventory (over 10^3 lb) of the nonburstered munitions causes some special considerations for a puncture release. A puncture is interpreted to consist of a 1.5-in. diameter hole. The agent flow rate out the hole is approximately 100 lb/min, which means that the entire munition inventory spills out in about 1/4 h. In the UPA, the spill is limited to 2140 ft^2 of floor area during the initial 10 min before the liquid flows to the sump. when 379 lb of agent spills into this area, a critical pool thickness is reached, namely 1/32 in., and the evaporation rate levels off. After 10 min, the sump will be overflowed for certain munitions. The pool area is calculated based on a slope of 1/4 in. for each foot of floor space and the evaporation rate is adjusted for that area.

Results of the inventory and release calculations for nonburstered munitions are summarized in Table 10-8. The effect of fire in the UPA is found to be most important.

10.2.4. Transport Releases

10.2.4.1. Onsite Transport Releases. For onsite truck transport, each truck will carry one OFC (for rail or air transport) or one vault (for marine shipment). The agent inventory of each OFC is summarized in Table 10-3 for the various munitions. Two ton containers (agent H) are carried in the vaults.

Table 10-9 presents the truck accident release calculations for the marine transport option. Those sequences where no release values are given were screened out on the backs of low frequency. Note that no detonation releases occurs because only ton containers are involved. The only significant release sequence is VW7, involving aircraft crash, mechanical rupture, and evaporation.

Table 10-10 presents the corresponding release calculations for the air transport option. Onsite transport releases for the rail transport option are the same as for the air transport option.

10.2.4.2. Offsite Transport - Air. The assumptions made for agent releases during aircraft accidents are as follows:

1. Given a severe impact release involving burstered munitions, 0.15 will detonate, 0.70 will spill, and 0.15 will scatter but remain intact.

2. Given a severe impact release involving nonburstered munitions, all agent will spill.

TABLE 10-9

RESULTS OF AGENT RELEASE FOR ONSITE TRANSPORT ACCIDENT SEQUENCES (MARINE OPTION)

Scenario	APG Frequency	Agent Available	Spilled (lb)	Destroyed (lb)	Vapor (lb)	Detonated (lb)	Duration Time
VWKHS001	0.0	3400	--	--	--	--	--
VWKHS002	0.0	3400	--	--	--	--	--
VWKHS003	2.7×10^{-11}	3400	--	--	--	--	--
VWKHF005	0.0	2400	1700	--	--	--	2 h
VWKHS006	7.2×10^{-7}	3400	2890	--	--	--	Instant
VWKHS007	5.9×10^{-8}	3400	--	3315	85	--	20 min
VWKHS009	0.0	3400	--	--	--	--	--
VWKHS010	0.0	3400	--	--	--	--	--
VWKHS011	1.2×10^{-9}	1700	--	--	--	--	2 h
VWKHS013	0.0	3400	--	--	--	--	--
VWKHS014	1.1×10^{-10}	3400	1700	--	--	--	2 h

TABLE 10-10
RESULTS OF ONSITE TRANSPORT RELEASE ANALYSIS - AIR OPTION

Scenario	Agent Available[a]	Spilled (lb)	Destroyed (lb)	Vapor (lb)	Detonated (lb)	Duration Time
VAKHS001	3400	--	--	--	--	--
VAPGS001	760	--	--	--	--	--
VAPHS001	1404	--	--	--	--	--
VAPVS001	756	--	--	--	--	--
VAQGS001	870	--	--	--	--	--
VARGS001	645	--	--	--	--	--
VARVS001	612	--	--	--	--	--
VAKHS002	3400	--	--	--	--	--
VAPGS002	760	--	--	--	--	--
VAPHS002	1404	--	--	--	--	--
VAPVS002	756	--	--	--	--	--
VAQGS002	870	--	--	--	--	--
VARGS002	645	--	--	--	--	--
VARVS002	612	--	--	--	--	--
VAKHS003	3400	1700.0	--	--	--	2 h
VAPGS003	760	6.5	--	--	--	2 h
VAPHS003	1404	11.7	--	--	--	2 h
VAPVS003	756	6.3	--	--	--	2 h
VAQGS003	870	14.5	--	--	--	2 h
VARGS003	645	10.75	--	--	--	2 h
VARVS003	612	10.2	--	--	--	2 h
VAPGC004	760	--	--	--	--	--
VAPHC004	1404	--	--	--	--	--
VAPVC004	756	--	--	--	--	--
VAQGC004	870	--	--	--	--	--
VARGC004	645	--	435.37	48.3	161.25	20 min
VARVC004	612	--	447.5	11.5	153.0	20 min
VAKHF005	3400	--	--	--	--	--
VAKHS006	3400	3400.0	--	--	--	Instant
VAPGC006	760	532.0	--	--	114.0	Instant
VAPHC006	1404	982.8	--	--	210.6	Instant
VAPVC006	756	529.2	--	--	113.4	Instant
VAQGC006	870	609.0	--	--	130.5	Instant
VARGC006	645	451.5	--	--	96.75	Instant
VARVC006	612	428.4	--	--	91.8	Instant

TABLE 10-10 (Continued)

Scenario	Agent Available[a]	Spilled (lb)	Destroyed (lb)	Vapor (lb)	Detonated (lb)	Duration Time
VAKHF007	3400	--	3230.0	170.0	--	20 min
VAPGC007	760	--	513.0	57.0	190.0	20 min
VAPHC007	1404	--	1000.3	52.7	351.0	20 min
VAPVC007	756	--	552.8	14.2	189.0	20 min
VAQGC007	870	--	587.2	65.3	217.5	20 min
VARGC007	645	--	435.37	48.3	161.25	20 min
VARVC007	612	--	447.5	11.5	153.0	20 min
VAKHS009	3400	--	--	--	--	--
VAPGS009	760	--	--	--	--	--
VAPHS009	1404	--	--	--	--	--
VAPVS009	756	--	--	--	--	--
VAQGS009	870	--	--	--	--	--
VARGS009	645	--	--	--	--	--
VARVS009	612	--	--	--	--	--
VAKHS010	3400	--	--	--	--	--
VAPGS010	760	--	--	--	--	--
VAPHS010	1404	--	--	--	--	--
VAPVS010	756	--	--	--	--	--
VAQGS010	870	--	--	--	--	--
VARGS010	645	--	--	--	--	--
VARVS010	612	--	--	--	--	--
VAKHS011	3400	1700.0	--	--	--	2 h
VAPGS011	760	6.5	--	--	--	2 h
VAPHS011	1404	11.7	--	--	--	2 h
VAPVS011	756	6.3	--	--	--	2 h
VAQGS011	870	14.5	--	--	--	2 h
VARGS011	645	10.75	--	--	--	2 h
VARVS011	612	10.2	--	--	--	2 h
VAPGC012	760	--	513.0	57.0	190.0	20 min
VAPHC012	1404	--	1000.3	52.7	351.0	20 min
VAPVC012	756	--	552.8	14.2	189.0	20 min
VAQGC012	870	-	587.2	65.3	217.5	20 min
VARGC012	645	--	435.4	48.4	161.3	20 min
VARVC012	612	--	447.5	11.5	153.0	20 min
VAKHF013	3400	--	3315.0	85.0	--	1 h

TABLE 10-10 (Continued)

Scenario	Agent Available[a]	Spilled (lb)	Destroyed (lb)	Vapor (lb)	Detonated (lb)	Duration Time
VAKHS014	3400	1700.0	--	--	--	2 h
VAPGS014	760	6.5	--	--	--	2 h
VAPHS014	1404	11.5	--	--	--	2 h
VAPVS014	756	6.3	--	--	--	2 h
VAQGS014	870	14.5	--	--	--	2 h
VARGS014	645	10.75	--	--	--	2 h
VARVS014	612	10.2	--	--	--	2 h
VAPGS015	760	32.5	--	--	6.5	Instant
VAPHS015	1404	58.5	--	--	11.7	Instant
VAPVC015	756	31.5	--	--	6.3	Instant
VAQGC015	870	72.5	--	--	14.5	Instant
VARGC015	645	623.5	--	--	21.5	Instant
VARVC015	612	591.6	--	--	20.4	Instant

[a]From Table 1-2, "Transportation of Chemical Agents and Munitions: A Concept Plan," U.S. Army, June 15, 1987.

3. Given a moderate impact, no release occurs due to impact alone.

4. Given a fire only with release involving burstered munitions, 0.25 detonates and 0.75 spill. The fire release fraction (Section 10.1.4) is applied to the spilled inventory (10% for GB, 5% for H, and 2.5% for VX).

5. Given a fire only with release involving nonburstered munitions, all agent spills. The fire release fraction is applied to the spilled agent.

6. Given a severe impact and a fire release, 0.25 detonates and 0.75 spills. The fire release fraction is applied to the spilled agent.

7. Given a moderate impact and a fire release, all agent spills. The fire release fraction is applied to the entire inventory.

Table 10-11 presents the agent release results in unclassified form (fraction of inventory released).

Table 10-12 presents the agent releases for marine transport accident sequences. The key parameter for evaporation releases is the fraction of agent spilled which does not sink but remains on the surface. These results are listed even for certain sequences which were screened out based on low frequency.

10.2.5. Uncertainties

No uncertainty analysis was performed for the agent release analysis. The releases reported are treated as conservative estimates, rather than central (e.g., median) estimates, since they are based on assumptions which are often conservative. Examples are: (1) use of

TABLE 10-11
RELEASE CONSEQUENCES FOR THE AIR TRANSPORT MODE

Origination	Scenario	Fraction Detonated	Fraction Spilled or Vaporized	Fraction Burned
APG on C-141	ABKHA001	0	1.0	0
	ABKHA002	0	0	0
	ABKHF003	0	0	0
	ABKHC004	0.25	0.075	0.675
	ABKHC005	0	0	0
APG on C-5	ABKHA001	0	1.0	0
	ABKHA002	0	0	0
	ABKHF003	0	0.1	0.9
	ABKHC004	0.25	0.075	0.675
	ABKHC005	0	0.1	0.9
LBAD on C-141	ABKGA001	0	1.0	0
	ABKGA002	0	0	0
	ABKGF003	0	0	0
	ABKGC004	0.25	0.075	0.675
	ABKGC005	0	0	0
LBAD on C-5	ABKGA001	0	1.0	0
	ABKGA002	0	0	0
	ABKGF003	0	0.1	0.9
	ABKGC004	0.25	0.075	0.675
	ABDGC005	0	0.1	0.9
LBAD on C-141	ABPZA001	0.15	0.85	0
	ABPZA002	0	0	0
	ABPZF003	0	0	0
	ABPZC004	0.25	0.075	0.675
	ABPZC005	0	0	0
LBAD on C-5	APBZA001	0.15	0.85	0
	ABPZA002	0	0	0
	ABPZF003	0.25	0.075	0.675
	ABPZC004	0.25	0.75	0.675
	ABPZC005	0	0.1	0.9
LBAD on C-141	ABRZA001	0.15	0.85	0
	ABRZA002	0	0	0
	ABRZF003	0	0	0
	ABRZC004	0.25	0.01875	0.73125
	ABRZC005	0	0	0
LBAD on C-5	ABRZA001	0.15	0.85	0
	ABRZA002	0	0	0
	ABRZF003	0.25	0.0187	0.73125
	ABRZC004	0.25	0.01875	0.73125
	ABRZC005	0	0.025	0.975

Note: Z = H mustard; G GB nerve; V VX nerve

TABLE 10-12
MARINE TRANSPORT AGENT RELEASES

Sequence	Variable	Barge BI	Lash LI	Lash LC	Lash LS
001, 002 Collisions	No. TCs failed	8	56	56	56
	Inventory involved, lb	13,600	95,20	95,200	95,200
	Evaporation release, lb	175	1,225	1,225	1,225
	Fire release, lb	0	0	0	0
	Percent failed inventory floating	5	5	5	5
003, 004 Collisions + fire	No. TCs failed	8	56	56	56
	Inventory involved, lb	13,600	95,200	95,200	95,200
	Evaporation release, lb	0	0	0	0
	Fire release, lb	170	1,190	1,190	1,190
	Percent failed inventory floating	25	25	25	25
005, 006 Rammings	No. TCs failed	4	32	32	32
	Inventory involved, lb	6,800	54,400	54,400	54,400
	Evapoartion release, lb	87.5	700	700	700
	Fire release, lb	0	0	0	0
	Percent failed inventory floating	5	5	5	5
007, 008 Rammings + fire	No. TCs failed	4	32	32	32
	Inventory involved, lb	6,800	54,400	54,400	54,400
	Evaporation release, lb	0	0	0	0
	Fire release, lb	85	680	680	680
	Percent failed inventory floating	25	25	25	25
009 through 012 Groundings	No. TCs failed	4	68	68	68
	Inventory involved, lb	6,800	115,600	115,600	115,600
	Evapoartion release, lb	0	0	0	0
	Fire release, lb	0	0	0	0
	Percent failed inventory floating	0	0	0	0

TABLE 10-12 (Continued)

Sequence	Variable	Barge BI	Lash LI	Lash LC	Lash LS
013, 014 Weater damage	No. TCs failed	1	68	68	68
	Inventory involved, lb	1,700	115,600	115,600	115,600
	Evaporation release, lb	21.9	1,488	1,488	1,488
	Fire release, lb	0	0	0	0
	Percent failed inventory floating	5	5	5	5
015, 016 Weather damage + fire	No. TCs failed	1	68	68	68
	Inventory involved, lb	1,700	115,600	115,600	115,600
	Evaporation release, lb	0	0	0	0
	Fire release, lb	21.3	1,445	1,445	1,445
	Percent failed inventory floating	25	25	25	25
017, 018 Spontaneous fire	No. TCs failed	1	1	1	1
	Inventory involved, lb	1,700	1,700	1,700	1,700
	Evaporation release, lb	0	0	0	0
	Fire release, lb	85	85	85	85
	Deton release	0	0	0	0
	Percent failed inventory floating	100	100	100	100
019 through 022	No. TCs failed	0	0	0	0
	Inventory involved, lb	0	0	0	0
	Evaporation release, lb	0	0	0	0
	Fire release, lb	0	0	0	0
	Percent failed inventory floating	N/A	N/A	N/A	N/A
023 Aircraft	No. TCs failed	560	2,240	2,240	2,240
	Inventory involved, lb	9.5×10^5	3.8×10^6	3.8×10^6	3.8×10^6
	Evaporation release, lb	0	0	0	0
	Fire release, lb	0	0	0	0
	Deton release, lb	0	0	0	0

early thresholds of munition failure relative to the data (Appendix F), (2) worst-case number of adjacent munition ruptures for a munition detonation in a pallet, (3) use of maximum rather than average inventories, and (4) upper bound fire release factors, relative to the data.

10.3. REFERENCES

10-1. Arthur D. Little, Inc., "Analysis of Risks Associated with Operation of Onsite M55 Rocket Demilitarization Plans," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-3, May 1985.

10-2. Arthur D. Little, Inc., "Analysis of Risks Associated with Operation of the JACADS M55 Rocket Demilitarization Plant," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-9, May 1985.

10-3. Arthur D. Little, Inc., "Analysis of Converted M55 Rocket Demilitarization Plant at Pine Bluff Arsenal," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-10, May 1985.

10-4. Arthur D. Little, Inc., "Analysis of Risks Associated with Operation of the CAMDS M55 Rocket Demilitarization Plant," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-11, May 1985.

10-5. Arthur D. Little, Inc., "M55 Rocket Separation Study," U.S. Army Toxic and Hazardous Materials Agency, M55-OD-08, November 1985.

10-6. "Design Development Test Results: Cryo-Pretreatment System Explosive Propagation Tests," GA Technologies Inc. Report 908644, February 1986.

10-7. "Black Hills Army Depot Hazard Classification Tests, USATECOM Project 5-3-0135-03," Disposition Form, STEDP-TO, Test Division, Dugway Proving Ground, Dugway, Utah, to Chief, Test Design and Analysis Office, DPG, June 3, 1966.

10-8. "Risk/Hazard Analysis for Hypothetical Accident/Incident at Selected Locations Along the CONUS Shipment Route for Project Red Hat," U.S. Army Munitions Command Operations Research Group Report 42, March 1970.

10-9. Taylor, W. T., and F. J. Massaro, "Hazard Classification Tests of Igloo Storage of GB-VX-Filled M55 Rockets," Department of the Army, Dugway Proving Ground Data Report (DPGDR)C505, USATECOM Project 5-3-0135-02, April 1966.

10-10. "Supporting Calculations for the Risk Analysis of the Disposal of Chemical Munitions at National or Regional Sites," GA Technologies Inc., EPS-GA/DP-0092 (Issue 2), Volumes 1, 2, and 3, August 1987.

10-11. Whitacre, C. G., et al., "Personal Computer Program for Chemical Hazard Prediction (D2PC), U.S. Army AMCC Report CRDEC-TR-87021, January 1987.

11. RESULTS

The analysis of the potential for agent release to the atmosphere from accident scenarios related to the collocation disposal option included the following major activities: (1) storage, (2) handling activities associated with the transport of munitions, (3) onsite transportation, (4) offsite transportation, and (5) plant operations associated with the demilitarization of munitions. This section discusses some of the accident probability and agent release results associated with these activities.

The results of the analysis of the various activities encompassing the collocation options cannot be presented in the same units, i.e., annual frequencies, because of the possible divulgence of classified information. This is only possible for some storage and plant operation accident scenarios. For accident scenarios related to the handling activities either at the original site, the regional site, or the national site, the unclassified portion of the probabilistic analysis is given in terms of frequency of accidents per pallet of munitions (or as a container of munitions). For onsite and offsite transportation accidents, the basic results are reported in terms of accident frequency per vehicle mile. These probabilities/unit are then multiplied by the number of handling operations or vehicle miles traveled during the stockpile disposal program.

The evaluation of the actual risk to the public and environment requires agent dispersion calculations which are not in the scope of the study reported here. Despite this limitation, the results discussed herein still provide useful insights on the contributions of the various disposal activities to the risk of an agent release. These insights are discussed below.

11.1. ACCIDENT SCENARIOS DURING STORAGE

The collocation alternative requires some storage of munitions in their existing location prior to transportation to the disposal site. In addition, it requires storage of munitions in offsite transport containers at the sending and receiving sites and some storage at the disposal site before movement to the demilitarization facility.

11.1.1. Internal Events

There were no significant internal event initiators of accidents during storage at the disposal site before movement to the demilitarization facility. Per unit operation, forklift drop accidents occur more frequently than forklift tine punctures. Also, the use of a lifting beam instead of a tine leads to an order of magnitude decrease in drop frequency.

11.1.2. External Events

These events involve accidents caused by natural phenomena or human activity affecting munitions in storage igloos, open storage areas, holding areas, or warehouses. If these are assumed to be full of munitions, the agent inventories range up to 100, 200, 1000, and 2000 tons, respectively, for storage igloos, holding areas, open areas, and warehouses. The most frequent external accidents having significant release involve mild intensity earthquakes or small airplane crashes (order depending on site). Amounts of available agent inventories released in these events are on the order of fractions of one percent or less (munition punctures, drops, etc.).

The largest releases occur for a large aircraft crash, a meteorite strike, or a severe earthquake, especially when a warehouse (at NAAP, TEAD, or UMDA) is involved. These can result in up to 10 percent of the agent inventory released for scenarios involving a fire which has

the potential (duration) for destroying the entire inventory of an igloo or warehouse. The munitions stored in warehouses contain only VX or mustard which have much slower evaporation rates than GB and hence are not easily dispersed into the atmosphere. Thus, warehouse scenarios involving only spills are not significant risk contributors. The warehouse at UMDA has the potential for the largest release. Meteorite strike-initiated sequence median frequencies are one to two orders of magnitude lower than the aircraft crash-induced sequence frequencies. As expected, munitions stored outdoors are generally more susceptible to large aircraft crashes than those stored in warehouses or igloos, but releases are lower. Both APG and PBA have ton containers stored outdoors, and the aircraft crash probabilities at these sites are somewhat higher than at the other sites. Igloos appear to provide only minimal protection from direct crashes of large planes, but releases are an order of magnitude lower. The releases are more severe if burstered munitions are involved.

11.2. ACCIDENT SCENARIOS DURING HANDLING

Included in the handling analysis are (1) single munition or pallet movements by hand, forklift, or other equipment; (2) packing or unpacking pallets into transportation containers; (3) loading and unloading packages from trucks, railcars, aircraft, or barges; or (4) loading and off-loading barges into the oceanfaring vessel (LASH).

There are twice as many handling operations at the receiving sites (RDC or NDC) involving collocated munitions that are not in any transportation container. Furthermore, there are more handling operations involving munitions in onsite transport containers (ONCs) than bare munitions or those in larger offsite transport containers (OFCs).

11.2.1. Handling for the Rail Alternative

The results indicate that dropped munitions, whether in palletized form or not, occur more frequently than either forklift tine puncture or forklift collision accidents. In fact, the frequency of forklift collision accidents which lead to the munitions falling off the forklift is an order of magnitude lower than the drop accidents. Furthermore, the type of clothing an operator is wearing while handling these munitions influence the drop frequency value. An operator wearing Level A clothing is more likely to commit an error that would cause the munition to be dropped than when he is wearing more comfortable clothing.

The results also indicate that spray tanks (in overpacks) have relatively higher drop frequencies than other munitions. This is largely due to the assumption that spray tanks will be lifted and moved to the truck (for loading or unloading) using forklift with tines. The drop frequency using the tines is an order of magnitude higher than with the use of lifting beams.

For bare munitions, the rockets seem to be the most prone to punctures from drops or forklift tine accidents. However, the ONC or OFC itself also affects the puncture probability. Because of its weight and larger surface area, the drop of an OFC increases the munition puncture probability by about a factor of 4 to 5 (depending on the munition type and packing density) when compared to a similar drop of an ONC. However, bare munitions have higher puncture probabilities than munitions in ONCs. This observation is of course not quite evident in the final results presented because there are more handling operations involving possible drops of ONCs than bare munitions.

Bulk items that are punctured lead to larger releases than other munitions such as projectiles or rockets. Bombs are of concern because they contain GB which evaporates more readily than the other agent types. The agent vapor releases range up to 400 lb (thermal failure of all munitions in an OFC).

Within the types of handling accidents, the events designated as HC, which are related to the packaging of munitions in ONCs or OFCs and their movement from storage (sending sites) to the munitions handling igloo (MHI) (receiving sites), predominate over handling accidents related to the facility (HF). This is largely because (1) there are more handling operations involved in the HC accidents, (2) HF accidents generally involve munitions in ONCs, which provides them with some protection from puncture, and (3) HF accidents involving bare munitions occur inside the munitions demilitarization buildup (MDB) which is designed for vapor containment; hence, including the probability of a detonation which destroys the vapor containment barrier, both the frequency of a release and the release itself are relatively lower.

The frequency results for the handling accidents could not be compared with the accidents from other activities, such as plant operations, because of differences in units. To get some perspective on how they compare on a yearly basis, we can estimate the number of pallets

that could be handled based on the plant annual processing rates. For illustrative purposes we calculate the number of bomb pallets that are required to meet the annual plant processing rate as:

$$5.4 \text{ bombs/h} \times 24 \text{ h/day} \times 5 \text{ day/week} \times 52 \text{ week/yr} / 2 \text{ bombs/pallet} = 16{,}848 \text{ pallets/yr} \quad .$$

By multiplying the HCl sequence frequency for TEAD (1.2×10^{-7}/pallet) with the number of pallets/yr, the annual frequency is 2.0×10^{-3}/yr. Thus, handling accidents which lead to significant agent releases (in particular, agent GB) are dominant risk contributors because of the relatively higher annual frequency values. Of course depending on the actual munition inventory, the value of annual frequency may either increase or decrease when converted to the more meaningful per stockpile basis.

11.2.2. Handling for the Air Option

The accident scenarios discussed for the rail option also apply to the air option. Since the air option involves only the movement of munitions from LBAD and APG to TEAD, agent releases from 155-mm projectiles, 8-in. projectiles, rockets and ton containers are of interest. The general observations noted in the discussion of the accident frequencies for the rail option (Section S.3.2.1) also apply here. The accident release is lower for the handling of these munitions since the amounts of GB agent contained in rockets and projectiles are quite small compared to bombs.

11.2.3. Handling for the Marine Option

For this option, the ton containers are placed in a transportation container (vault) that is different from the OFC; hence, the handling steps are somewhat different. There are eight sequences related to handling that were identified. Sequence HW34, which involves the dropping

of a lighter by a crane while loading into or unloading from the lighter aboard ship (LASH) vessel, has a relatively high frequency of 6.0×10^{-6} per shipment. The structural analysis indicates that dropping of the lighter from a height of about 70 ft onto an unyielding surface of the LASH vessel could cause the crushing of several ton containers inside the lighter. The agent will be confined in the interior of the ship, and the amount of agent released to the atmosphere is small.

11.3. ACCIDENT SCENARIOS DURING PLANT OPERATIONS

Included in the analysis for this phase are all malfunctions during agent processing/incineration within the MDB or external events affecting drained and undrained agent in the MDB, including those in the unpack area (UPA) (up to 10^4 lb of agent available) and munitions awaiting processing in the MHI, up to 3×10^4 lb of agent available. After unpacking, the munitions are processed by conveyor to the burster removal area, mine punch-and-drain area, projectile mortars disassembly area, rocket and burster shearing machines, mine machine for burster removal, a bulk item drain station, a toxic cubicle (TOX) agent storage tank, furnaces for explosive deactivation, metal parts decontamination, and agent and dunnage incinerators, as appropriate.

11.3.1. Internal Events

Because of the engineered safety features provided in the plant design, both the frequency of release and magnitude of release associated with accidents initiated by equipment failure and human error are relatively small. Among the large number of accident scenarios analyzed, the highest frequency scenario (P052) is initiated by an inadvertent feed of an unpunched bursted munition to the dunnage incinerator (10^{-2}/yr for mines; 5×10^{-3}/yr for other munitions). As a result of detonation, one burstered munition inventory is released to the atmosphere as vapor (only up to 15 lb of agent).

The largest amount of agent vapor release occurs for a metal parts furnace explosion (P044) with ventilation failure (one bulk item inventory release, up to 1700 lb). However, this scenario was assessed to have a very low frequency, around 10^{-10}/yr. Another event with up to several hundred pounds of vapor release is P048, munition detonation in the explosive containment room vestibule with subsequent fire spreading to unpacked munitions. However, this scenario also has a low frequency, around 10^{-9}/yr.

11.3.2. External Events

Aircraft crashes dominate the external event frequency, and there is little difference between direct and indirect crashes. The small difference is attributed to offsetting effects. Although the indirect crash has smaller conditional probabilities of failures than the direct crash, the risk model utilizes a larger target area for the indirect crash. There is very little distinction in the frequency of aircraft crashes with or without fire, since historical data indicate that there is roughly a 50 percent chance that the crash of an aircraft will involve a fire. The frequency of a crash onto the MDB is considerably larger than that for the MHI because the surface area of the MDB is more than 30 times larger than the MHI.

The frequency of large aircraft crashes is estimated to be higher at ANAD than it is for TEAD. This impacts the regional versus national collocation option. The accident scenario involving the crash of an airplane onto the outdoor agent piping system for the modified CAMDS facility at TEAD has a frequency of about 10^{-8}/yr with up to 55 lb of vapor release. This scenario includes both large and small aircraft crashes. The frequency of small aircraft (including helicopters) crashes is at least two orders of magnitude higher than the frequency of large aircraft crashes at TEAD.

The frequencies of earthquake-induced accident scenarios are generally higher for TEAD than for ANAD since TEAD is located in a region more prone to earthquakes. Sequence P033, which represents an earthquake-initiated munition fall and fire but with the MDB and TOX intact, has the highest frequency (2×10^{-6}/yr for ANAD and 5×10^{-5}/yr for TEAD). This sequence involves the detonation of all munitions (if burstered) in the UPA since the fire is not suppressed in this sequence.

All accident sequences related to tornadoes or meteorites were estimated to occur at frequencies of less than 10^{-10}/yr and thus were screened out.

11.4. ACCIDENT SCENARIOS DURING TRANSPORT

11.4.1. Onsite Transportation

There are two truck transportation phases considered in the analysis. At the sending sites, munitions in offsite transportation packages are transported by truck to the holding area prior to loading into the train, airplane, or barge. The accidents are identified as the VR, VA, or VW (i.e., for rail, air, and water, respectively) scenarios. At the receiving sites, munitions still in offsite packages are moved to storage locations where they are removed from the offsite package and stored until they are ready for demilitarization. The accidents are also coded VR or VA. Finally, when munitions at their storage locations are ready for demilitarization, they are transferred into onsite containers and then moved by truck to the MHI. The accidents are identified as VO scenarios to distinguish between the transportation risk of using an onsite package versus an offsite package (different failure thresholds). The agent available in a truck carrying an OFC is less than 3400 lb, while up to 7000 lb is available for an ONC truck transport.

As a result of analysis for both internally initiated events (human error or equipment failure) and externally initiated events, the following conclusions were reached:

1. The offsite transportation package provides munitions with more protection from crush forces generated from truck accidents than the onsite package. Hence, sequences with OFC crush have insignificant accident frequency whereas scenarios with ONC crush have frequencies up to 10^{-8}/truck-mile.

2. Both packages provide similar protection from impact forces. The results show that accident frequencies resulting in impact failure are insignificant. This is largely due to the administrative control to be imposed during truck travel which

limits truck speed to no more than 20 mph. The impact forces at this velocity are not sufficient to breach the containment.

3. The probability of puncture resulting from truck collision/overturn is at least an order of magnitude higher for offsite containers than onsite containers. This results from the higher likelihood of generating a probe sufficient to puncture the container and the munition when the accident involves a large package such as the OFC.

4. Truck accidents which generate fires are more likely to detonate burstered munitions inside onsite packages, since they provide only a 15-min protection from an all engulfing fire (versus 2 h for the OFC). However, all these scenario frequency results are also quite low because of the administrative control for limiting the amount of fuel in the truck so as not to exceed a 10-min fire.

5. When rockets are involved in the accidents which generate sufficient impact forces to cause propellant ignition, there is very little distinction in the results for the two packages.

6. For tornado-initiated accidents, puncture as a result of truck overturn is the dominant contributor to the sequence frequency.

7. Generation of undue forces during truck accidents that could cause burster detonations has a small contribution to the overall truck transportation risk.

8. The amount of agent spilled or burned during truck accidents resulting in the breach in containment by puncture forces generally involve the agent content of one munition. Up to 10 percent is released as vapor.

9. Both containers can fail when an aircraft crashes into the truck (VR6, VR7, VO6, VO7). The entire truckload is involved, and up to 10 percent is released as a vapor. Hence, aircraft crash-initiated truck accidents have the most severe consequences. It should be noted, however, that none of the accident sequences has a frequency greater than 10^{-7}/yr.

11.4.2. Offsite Transport - Rail

In this option, munitions in OFCs are transported by rail either to two regional destruction centers (RDC-ANAD or RDC-TEAD) or a single national destruction center (NDC-TEAD). The agent inventory available per railcar ranges up to 7000 lb. Results of the accident analysis indicate the following:

1. Rail accident crush and impact forces are very unlikely to fail an OFC and munition inside.

2. The major risk contribution due to mechanical failure comes from a probe such as a railcar coupler (generated from train accidents) capable of puncturing the OFC and the munition. Munition failure frequency by puncture (RC3) is about an order of magnitude higher than train accidents which lead to fire and cause the thermal detonation or rupture of munitions (RC4 and RC5). However, the consequence (i.e., agent release) from the latter sequence is more severe.

3. For tornado-initiated accidents (RC14), puncture as a result of train derailment is the dominant contributor to the agent release frequency.

4. Aircraft crash into a train can damage the munitions (RC6 and RC7). The crash can involve one or two railcars (i.e., up to four OFCs). The largest amounts of agent released are from the bulk items (bombs, ton containers, and spray tanks). A

maximum of 10 percent of the inventory is released as vapor (up to 1400 lb). This is the largest release for rail scenarios.

11.4.3. Offsite Transport - Air Option

The air transport option applies only to the movement of ton containers from APG to TEAD, and rockets and projectiles from LBAD to TEAD. Five generic sequences related to air transport were identified. These scenarios were evaluated for both the C-141 and C-5 aircrafts. There will be approximately 1500 flights from LBAD and 300 flights from APG for the C-141 aircraft. The C-5 aircraft would decrease the number of required flights by one fourth. The analysis also differentiated among accidents which occur during takeoff, while in flight, and during landing. Each flight would carry up to 3400 lb of agent inside OFCs.

The aircraft accident frequency during landing is about seven times higher than during takeoff and about three times higher than inflight accidents. However, the failure probability of the package due to impact forces is higher inflight than either takeoff or landing. If an aircraft crash occurs, the OFC and the munitions are subjected primarily to impact forces sufficient to fail the package. The accident frequencies from sequences which involve impact only are almost of the same order of magnitude as sequences which involve impact and fire (AA1 versus AA20). The accident frequencies involving the C-5 aircraft are an order of magnitude higher than those for C-141 aircraft. A compensating factor is that there will be 75 percent fewer flights if the C-5 is used.

Accident scenarios involving fire of sufficient duration to fail the packages are not credible for the C-141 aircraft because of insufficient fuel available to sustain a fire of duration to fail the package containment.

Accidents which lead to severe impact (AA1 and AA2; AB1 and AB2) without fire have the highest frequency and also lead to the largest amounts of agent released. For severe impact release involving burstered munitions, some of the munitions contained in the aircraft will detonate, and up to just over 400 lb will be released as vapor. For accidents involving moderate impact forces, no agent release occurs from impact alone. The moderate impact accident must be accompanied by fire to fail the package thermally.

11.4.4. Offsite Transport - Marine Option

The marine option was analyzed only for the movement of ton containers filled with mustard at APG to the Johnston Atoll. There were five groups of initiating events identified. Impact and puncture are not the dominant failure forces experienced in marine accidents. The cargo will be adequately braced to hold it in place. Furthermore, most of the events are low-velocity, high-momentum events; hence, the dominant failure mode is crush. Fire, immersion, and aircraft crash events were also considered because of the large amount of agent being transported which could be involved in fire or sinking accidents.

The results indicate that:

1. For the lighters in the Chesapeake Bay, collision accidents are at least three orders of magnitude more probable than either rammings or groundings.

2. For the LASH vessel in the Chesapeake Bay, both grounding and collision accidents are at least one order of magnitude more probable than rammings.

3. Grounding of the LASH vessel in the coastal areas is less likely than in shallower inland waters.

4. For the LASH vessel in high seas, collision is still the predominant event. However, grounding results in more severe consequences.

The agent release analysis shows that collisions result in the largest number of ton containers (TCs) which fail (8) for barges, but that groundings or heavy weather damage results in the maximum number of TCs failed (68) for the LASH (except for aircraft crash, which is below the frequency screening threshold). The largest amount of agent vapor release to the atmosphere occurs for these worst events, and the amounts are not strongly dependent on whether fire occurs or not. Although a large inventory (up to 4 million lb on the LASH) is available, no accident leads to a release of more than 0.1 percent.

11.5. UNCERTAINTIES IN THE ANALYSIS

In assessing the risks associated with the CSDP alternatives, every effort was made to perform best-estimate analyses, i.e., "realistic" evaluation and quantification of the accident sequence frequencies and associated agent releases. The use of pessimistic or conservative modeling techniques or data for quantification violates the intent of the probabilistic nature of the study. Realistic modeling and quantification permits a balanced evaluation of risk contributors and comparison of alternatives. However, for realistic or best-estimate calculations, the obvious concern is the accuracy of the results. Uncertainty analysis addresses this concern.

11.5.1. Sources of Uncertainty

Since the event sequences discussed in Section S.3 have not actually occurred, it is difficult to establish the frequency of the sequence and associated consequences with great precision. For this reason, many parameters in a risk assessment are treated as probabilistically distributed parameters, so that the computation of sequence frequencies and resulting consequences can involve the probabilistic combination of distributions.

There are three general types of uncertainty associated with the evaluations reported in this document: (1) modeling, (2) data, and (3) completeness.

There exist basic uncertainties regarding the ability of the various models to represent the actual conditions associated with the sequence of events for the accident scenarios that can occur in the storage and disposal activities. The ability to represent actual phenomena with analytical models is always a potential concern. The use of fundamental models such as fault trees and event trees is sometimes simplistic because most events depicted in these models are treated as

leading to one of two binary states: success or failure (i.e., partial successes or failures are ignored). Model uncertainties are difficult to quantify and are addressed in this study by legitimate efforts of the analysts to make the models as realistic as possible. Where such realism could not be achieved, conservative approaches were taken.

No uncertainty from oversights, errors, or omission from the models used (e.g., event trees and fault trees) is included in the uncertainty analysis results. Including these uncertainties is beyond the state-of-the-art of present day uncertainty analysis.

The uncertainties in the assignment of event probabilities (e.g., component failure rates and initiating event frequencies) are of two types: intrinsic variability and lack of knowledge. An example of intrinsic variability is that where the available experience data is for a population of similar components in similar environments, but not all the components exhibit the same reliability. Intrinsic variations can be caused, for example, by different manufacturers, maintenance practices, or operating conditions. A second example of intrinsic variability is that related to the effects of long-term storage on the condition of the munitions as compared to their original configuration. Lack of knowledge uncertainty is associated with cases where the model parameter is not a random or fluctuating variable, but the analyst simply does not know what the value of the parameter should be. Both of these data uncertainty types are encountered in this study.

11.5.2. Uncertainties

The sequence frequency results discussed in this report are presented in terms of a median value and a range factor of a probability distribution representing the frequency of interest. The range factor represents the ratio of the 95th percentile value of frequency to the 50th percentile (i.e., median) value of frequency. The uncertainty in the sequence frequency is determined using the STADIC-2 program

(Ref. S-4) to propagate the uncertainties associated with each of the events in the fault trees or event trees through to the end result. Some scenarios, such as those associated with tornado missiles and low-impact detonations have rather large uncertainties. The difficulty with tornado-generated missiles lies with the difficulty in accurately modeling the probability that the missile will be in the proper orientation to penetrate the munition and in predicting the number of missiles per square foot of wind. The difficulty with the low-impact detonations lies with the sparse amount of data available and its applicability to the scenarios of interest. In general, uncertainties tend to be large when the amount of applicable data is small and vice versa.

APPENDIX A
REFERENCE LIST OF ACCIDENT SCENARIOS

A.1. REFERENCE LIST OF ACCIDENT SCENARIOS

A reference list of accident scenarios is presented here. The list is arranged by the particular demilitarization phase with which a given scenario is associated. Accident scenarios related to storage are presented first followed by plant operations, handling, onsite transport and offsite transport. The scenarios can be identified by the coding scheme presented in Section 4 of this document. Following the scenario ID, a brief description of the accident is given along with an indication as to whether or not the scenario was considered for further analysis. The bases for scenario screening are provided in the logic model section, Section 4, of the main body of this report.

STORAGE ACCIDENT SEQUENCES

Sequence ID	Sequence Description	Considered for Further Analysis
SL1	Munition develops a leak during the in-between inspection period.	Yes
SL2	Munition punctured by forklift tine during leaker-handling activities.	Yes
SL3	Spontaneous ignition of rocket during storage (not analyzed for lack of quantitative data).	No
SL4	Large aircraft direct crash onto storage area; fire not contained in 30 min. (Note: Assume detonation occurs if burstered munitions hit; fire involving burstered munitions not contained at all.)	Yes
SL5	Large aircraft indirect crash onto storage area; fire not contained in 30 min. (See note in SL4.)	Yes
SL6	Tornado-generated missiles strike the storage magazine, warehouse, or open storage area; munitions breached (no detonation).	Yes
SL7	Severe earthquake breaches the munitions in storage igloos; no detonations.	Yes
SL8	Meteorite strikes the storage area; fire occurs; munitions breached (if burstered, detonation also occurs).	Yes
SL9	Munition dropped during leaker isolation operation; munition punctured.	No
SL10	Storage igloo or warehouse fire from internal sources.	No
SL11	Munitions are dropped due to pallet degradation.	No
SL12	Liquid petroleum gas (LPG) infiltrates igloo/building.	No
SL13	Flammable liquids stored in nearby facilities explode, fire propagates to munition warehouse (applies to NAAP).	No

STORAGE ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
SL14	Tornado-induced building collapse leads to breaching/detonation of munitions.	No
SL15	Small aircraft direct crash onto warehouse or open storage yard; fire occurs; not contained in 30 min.	No
SL16	Large aircraft direct crash; no fire; detonation (if burstered).	Yes
SL17	Large aircraft direct crash; fire contained within 30 min (applies to nonburstered munitions only).	Yes
SL18	Small aircraft direct crash onto warehouse or open storage yard; no fire.	Yes
SL19	Small aircraft indirect crash onto warehouse or open storage yard; fire contained in 30 min.	Yes
SL20	Large aircraft indirect crash onto storage area; no fire.	Yes
SL21	Large aircraft indirect crash onto storage area; fire contained in 30 min.	Yes
SL22	Severe earthquake leads to munition detonation.	Yes
SL23	Tornado-generated missiles strike the storage igloo and leads to munition detonation.	Yes
SL24	Lightning strikes ton containers stored outdoors.	Yes
SL25	Munition dropped during leaker isolation; munition detonates.	Yes
SL261	Earthquake occurs; NAAP warehouse is intact; no ton containers damaged; fire occurs.	Yes
SL262	Earthquake occurs; NAAP warehouse is intact; ton container damaged; no fire.	Yes
SL263	Earthquake occurs; NAAP warehouse is intact; ton container damaged; fire occurs.	Yes

STORAGE ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
SL264	Earthquake occurs; NAAP warehouse is damaged; ton containers damaged; fire occurs.	Yes
SL265	Earthquake occurs; NAAP warehouse is damaged; ton containers; fire occurs.	Yes
SL271	Earthquake occurs; TEAD warehouses intact; munitions intact; fire occurs at one warehouse.	Yes
SL272	Earthquake occurs; TEAD warehouses intact; munitions intact; fire occurs at two warehouses.	Yes
SL273	Earthquake occurs; one TEAD warehouse is damaged; munitions intact; fire occurs at one warehouse.	Yes
SL274	Earthquake occurs; one TEAD warehouse is damaged; munitions intact; fire occurs at two warehouses.	Yes
SL275	Earthquake occurs; two TEAD warehouses damaged; munitions intact; fire occurs at one warehouse.	Yes
SL276	Earthquake occurs; two TEAD warehouses damaged; munitions intact; fire occurs at two warehouses.	Yes
SL281	Earthquake occurs; UMDA warehouses intact; munitions intact; fire occurs at one warehouse.	Yes
SL282	Earthquake occurs; UMDA warehouses intact; munitions intact; fire occurs at two warehouses.	Yes
SL283	Earthquake occurs; UMDA warehouses intact; munitions in one warehouse damaged; no fire occurs.	Yes
SL284	Earthquake occurs; UMDA warehouses intact; munitions in one warehouse damaged; fire occurs at warehouse with damaged munitions.	Yes
SL285	Earthquake occurs; UMDA warehouses intact; munitions in one warehouse damaged; fire occurs at warehouse with undamaged munitions.	Yes

STORAGE ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
SL286	Earthquake occurs; UMDA warehouses intact; munitions in one warehouse damaged; fire occurs at two warehouses.	Yes
SL287	Earthquake occurs; UMDA warehouses intact; munitions in two warehouses damaged; no fire occurs.	Yes
SL288	Earthquake occurs; UMDA warehouses intact; munitions in two warehouses damaged; fire occurs at warehouse with damaged munitions.	Yes
SL289	Earthquake occurs; UMDA warehouses intact; munitions in two warehouses damaged; fire occurs at two warehouses.	Yes
SL2810	Earthquake occurs; one UMDA warehouse damaged; munitions in one warehouse damaged; no fire occurs.	Yes
SL2811	Earthquake occurs; one UMDA warehouse damaged; munitions in one warehouse damaged; fire occurs at warehouse with damaged munitions.	Yes
SL2812	Earthquake occurs; one UMDA warehouse damaged; munitions in one warehouse damaged; fire occurs at two warehouses.	Yes
SL2813	Earthquake occurs; one UMDA warehouse damaged; munitions in two warehouses damaged; no fire occurs.	Yes
SL2814	Earthquake occurs; one UMDA warehouse damaged; munitions in two warehouses damaged; fire occurs at warehouse with damaged munitions.	Yes
SL2815	Earthquake occurs; one UMDA warehouse damaged; munitions in two warehouses damaged; fire occurs at two warehouses.	Yes
SL2816	Earthquake occurs; two UMDA warehouses damaged; munitions in two warehouses damaged; no fire occurs.	Yes

STORAGE ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
SL2817	Earthquake occurs; two UMDA warehouses damaged; munitions in two warehouses damaged; fire occurs at both warehouses.	Yes
<u>Rail Option</u>		
SR1	Large aircraft direct crash onto transportation containers in holding area; no fire.	Yes
SR2	Large aircraft direct crash onto transportation containers in holding area; fire not contained.	Yes
SR3	Large aircraft direct crash onto transportation containers in holding area; fire contained.	Yes
SR4	Small aircraft direct crash onto transportation containers in holding area; no fire.	Yes
SR5	Small aircraft direct crash onto transportation containers in holding area; fire not contained.	Yes
SR6	Small aircraft direct crash onto transportation containers in holding area; fire contained.	Yes
SR7	Tornado-generated missiles strike munitions in transportation containers in holding area; no detonation.	Yes
SR8	Tornado-generated missiles strike munitions in holding area; detonation occurs.	Yes
SR9	Meteorite strikes munitions in transportation containers in holding area; fire occurs; detonation (if burstered).	Yes
<u>Air Option</u>		
SA1	Large aircraft direct crash onto transportation containers in holding area; no fire.	Yes
SA2	Large aircraft direct crash onto transportation containers in holding area; fire not contained.	Yes
SA3	Large aircraft direct crash onto transportation containers in holding area; fire contained.	Yes

STORAGE ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
SA4	Small aircraft direct crash onto transportation containers in holding area; no fire.	Yes
SA5	Small aircraft direct crash onto transportation containers in holding area; fire not contained.	Yes
SA6	Small aircraft direct crash onto transportation containers in holding area; fire contained.	Yes
SA7	Tornado-generated missiles strike munitions in transportation containers in holding area; no detonation.	Yes
SA8	Tornado-generated missiles strike munitions in holding area; detonation occurs.	Yes
SA9	Meteorite strikes munitions in transportation containers in holding area; fire occurs; detonation (if burstered).	Yes
<u>Marine Option</u>		
SW1	Large aircraft direct crash cnto transportation containers in holding area; no fire.	Yes
SW2	Large aircraft direct crash onto transportation containers in holding area; fire not contained.	Yes
SW3	Large aircraft direct crash onto transportation containers in holding area; fire contained.	Yes
SW4	Small aircraft direct crash onto transportation containers in holding area; no fire.	Yes
SW5	Small aircraft direct crash onto transportation containers in holding area; fire not contained.	Yes
SW6	Small aircraft direct crash onto transportation containers in holding area; fire contained.	Yes
SW7	Tornado-generated missiles strike munitions in transportation containers in holding area; no detonation.	Yes

STORAGE ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
SW9	Meteorite strikes munitions in transportation containers in holding area; fire occurs.	Yes
SW10	Large aircraft direct crash onto a flotilla of lighters; no fire.	Yes
SW11	Large aircraft direct crash onto a flotilla of lighters; fire not contained.	Yes
SW12	Large aircraft direct crash onto a flotilla of lighters; fire contained.	Yes
SW13	Small aircraft direct crash onto a flotilla of lighters; no fire.	Yes
SW14	Small aircraft direct crash onto a flotilla of lighters; fire not contained.	Yes
SW15	Small aircraft direct crash onto a flotilla of lighters; fire contained.	Yes
SW16	Large aircraft direct crash onto LASH vessel (at rest); no fire.	Yes
SW17	Large aircraft direct crash onto LASH vessel (at rest); fire not contained.	Yes
SW18	Large aircraft direct crash onto LASH vessel (at rest); fire contained.	Yes
SW19	Small aircraft direct crash onto LASH vessel (at rest); no fire.	Yes
SW20	Small aircraft direct crash onto LASH vessel (at rest); fire not contained.	Yes
SW21	Small aircraft direct crash onto LASH vessel (at rest); fire contained.	Yes

OFFSITE TRANSPORT ACCIDENT SEQUENCES

Sequence ID	Sequence Description	Considered for Further Analysis
Main Transport		
BIKHS001	A collision occurs and crush forces fail agent containment.	No
LIKHS001		Yes
LCKHS001		Yes
LSKHS001		Yes
BIKHS002	A collision occurs and crush forces fail agent containment. Sinking also occurs.	Yes
LIKHS002		Yes
LCKHS002		Yes
LSKHS002		Yes
BIKHC003	A collision occurs and crush forces fail agent containment. A fire breaks out.	No
LIKHC003		Yes
LCKHC003		Yes
LSKHC003		Yes
BIKHC004	A collision occurs and crush forces fail agent containment. A fire breaks out and sinking occurs.	Yes
LIKHC004		Yes
LCKHC004		Yes
LSKHC004		
BIKHS005	A ramming occurs and crush forces fail agent containment.	No
LIKHS005		Yes
LCKHS005		Yes
LSKHS005		Yes
BIKHS006	A ramming occurs and crush forces fail agent containment. Sinking also occurs.	Yes
LIKHS006		Yes
LCKHS006		Yes
LSKHS006		Yes
BIKHC007	A ramming accident occurs and crush forces fail agent containment. A fire breaks out.	No
LIKHC007		Yes
LCKHC007		Yes
LSKHC007		Yes
BIKHC008	A ramming accident occurs and crush forces fail agent containment. A fire breaks out and sinking occurs.	Yes
LIKHC008		Yes
LCKHS008		Yes
LSKHC008		Yes
BIKHS009	A grounding accident occurs and crush forces fail agent containment.	No
LIKHS009		Yes
LCKHS009		Yes
LSKHS009		Yes

OFFSITE TRANSPORT ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
BIKHS010	A grounding accident occurs and crush forces fail	Yes
LIKHS010	agent containment. Sinking also occurs.	Yes
LCKHS010		Yes
LSKHS010		Yes
BIKHC011	A grounding accident occurs and crush forces fail	No
LIKHC011	agent containment. A fire breaks out.	Yes
LCKHC011		Yes
LSKHC011		Yes
BIKHC012	A grounding accident occurs and crush forces fail	Yes
LIKHC012	agent containment. A fire breaks out and sinking	Yes
LCKHC012	occurs.	Yes
LSKHC012		Yes
BIKHS013	Structural damage due to heavy weather occurs.	No
LIKHS013	Crush forces fail agent containment.	Yes
LCKHS013		Yes
LSKHS013		Yes
BIKHS014	Structural damage due to heavy weather occurs.	Yes
LIKHS014	Crush forces fail agent containment. Sinking	Yes
LCKHS014	occurs.	Yes
LSKHS014		Yes
BIKHC015	Structural damage due to heavy weather occurs.	No
LIKHC015	Crush forces fail agent containment. A fire	Yes
LCKHC015	breaks out.	Yes
LSKHC015		Yes
BIKHC016	Structural damage due to heavy weather occurs.	Yes
LIKHC016	Crush forces fail agent containment. A fire	Yes
LCKHC016	breaks out and sinking occurs.	Yes
LSKHC016		Yes
BIKHF017	Spontaneous fire occurs.	No
LIKHF017		Yes
LCKHF017		Yes
LSKHF017		Yes
BIKHC018	Spontaneous fire occurs. Sinking also occurs.	No
LIKHC018		Yes
LCKHC018		Yes
LSKHC018		Yes

OFFSITE TRANSPORT ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
BIKHS019	Collision accident occurs with no immediate release. Sinking also occurs.	Yes
LIKHS019		Yes
LCKHS019		Yes
LSKHS019		Yes
BIKHS020	Ramming accident occurs with no immediate release. Sinking also occurs.	Yes
LIKHS020		Yes
LCKHS020		Yes
LSKHS020		Yes
BIKHS021	Grounding accident occurs with no immediate release. Sinking also occurs.	Yes
LIKHS021		Yes
LCKHS021		Yes
LSKHS021		Yes
BIKHS022	Structural damage due to heavy weather occurs with no immediate release. Sinking also occurs.	Yes
LIKHS022		Yes
LCKHS022		Yes
LSKHS022		Yes
Rail Transport		
RCYZW001	A train accident involving a munitions railcar occurs and crush forces fail the agent containment.	No
RCYZW002	A train accident involving a munitions railcar occurs and impact forces fail the agent containment.	No
RCYZW003	A train accident involving a munitions railcar occurs and puncture forces fail the agent containment.	Yes
RCYZW004	A train accident with fire occurs. Either the package insulation is torn away due to mechanical forces and the fire is able to heat the munitions inside the package, or the fire lasts long enough to cause burstered munitions in the package to detonate. Undue force created by the accident may also cause burster detonation.	Yes

OFFSITE TRANSPORT ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
RCYZW005	A train accident with fire occurs. Either the package insulation is torn away due to mechanical forces and the fire is able to heat the munitions inside the package, or the fire lasts long enough to cause thermal rupture of the munitions inside the package.	Yes
RCYZW006	An aircraft crashes on a munitions railcar. No fire occurs, but impact forces lead to detonation and/or failure of agent containment.	Yes
RCYZW007	An aircraft crashes on a munitions railcar. Fire occurs, but impact forces lead to detonation and/or failure of agent containment.	Yes
RCYZW008	Combined with scenario RCYZW007.	No
RCYZW009	A severe earthquake occurs involving a munitions railcar and crush forces fail the agent containment.	No
RCYZW010	A severe earthquake occurs involving a munitions railcar and impact forces fail the agent containment.	No
RCYZW011	A severe earthquake occurs involving a munitions railcar and puncture forces fail the agent containment.	Yes
RCYZW012	A severe earthquake occurs involving a munitions railcar and subsequent fire detonates burstered munitions.	Yes
RCYZW013	A severe earthquake occurs involving a munitions railcar and subsequent fire fails nonburstered munitions.	Yes
RCYZW014	A tornado-generated missile leads to failure of the agent containment, or a tornado occurs, causing overturn or derailment of a munitions railcar.	Yes
RCYZW015	An earthquake or tornado occurs, generating undue mechanical forces which cause detonation of burstered munitions.	Yes

OFFSITE TRANSPORT ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
	Accident Scenarios for Air Transport to Tooele Army Depot	
ABYZA001 AAYZA001	A severe ground collision involving an aircraft with munitions occurs and impact forces fail the agent package and munitions.	Yes
ABYZA002 AAYZA002	A severe ground collision involving an aircraft with munitions occurs and impact forces fail the agent package and munitions. A subsequent fire occurs with a duration less than 2 h.	Yes
ABYZF003 AAYZF003	A fire occurs aboard an aircraft with munitions and causes rupture of the compartme t due to thermal expansion of the agent.	Yes
ABYZC004 AAYZC004	A severe ground collision involving an aircraft with munitions occurs and impact forces fail the agent package and munitions. A subsequent fire occurs with a duration greater than 2 h.	Yes
ABYZC005 AAYZC005	A moderate ground collision involving an aircraft with munitions occurs causing a breach of the package. A subsequent fire occurs causing a breach (by detonation or thermal expansion) of the agent compartment and agent is released.	Yes

From Aberdeen:

YZ = KH - CM package, 1-ton package, mustard

From Lexington:

YZ = PH - CM package, projectiles, mustard
RG - CM package, rockets, GB nerve
RV - CM package, rockets, VX nerve
PG - CM package, projectiles, GB nerve
PV - CM package, projectiles, VX nerve
KG - CM package, 1-ton packages, GB nerve

ONSITE TRANSPORT ACCIDENT SEQUENCES

Sequence ID	Sequence Description	Considered for Further Analysis
VOXYZ001	A munitions vehicle collision/overturn occurs and crush forces fail the agent containment.	Yes
VOXYZ002	A munitions vehicle collision/overturn occurs and impact forces fail the agent containment.	No
VOXYZ003	A munitions vehicle collision/overturn occurs and puncture forces fail the agent containment.	Yes
VOXYZ004	A munitions vehicle accident with fire occurs, causing detonation of burstered munitions. Ignition of the propellant by a probe could also detonate the burster of a cartridge and the burster of a rocket could be detonated by impact-induced ignition of the rocket propellant.	Yes
VOXYZ005	A munitions vehicle accident with fire occurs, causing nonburstered munitions to fail.	Yes
VOXYZ006	An aircraft crashes on a munitions vehicle. No fire occurs; impact forces fail the agent containment.	Yes
VOXYZ007	An aircraft crashes on a munitions vehicle. Fire occurs, but impact forces fail the agent containment.	Yes
VOXYZ009	A severe earthquake occurs, causing a munitions vehicle accident and crush forces fail the agent containment.	Yes
VOXYZ010	A severe earthquake occurs, causing a munitions vehicle accident and impact forces fail the agent containment.	No
VOXYZ011	A severe earthquake occurs, causing a munitions vehicle accident and puncture forces fail the agent containment.	Yes
VOXYZ012	A severe earthquake occurs, causing a munitions vehicle accident and fire detonates burstered munitions.	Yes

ONSITE TRANSPORT ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
VOXYZ013	A severe earthquake occurs, causing a munitions vehicle accident and fire fails nonburstered munitions.	Yes
VOXYZ014	A tornado occurs, generating a missile or causing a truck overturn and mechanical forces fail agent containment.	Yes
VOXYZ015	A truck collision/overturn occurs generating undue mechanical forces which cause detonation of burstered munitions.	Yes

TRUCK TRANSPORT FROM SENDING SITE TO RECEIVING SITE - OFFSITE
MARINE TRANSPORT ACCIDENT SEQUENCES

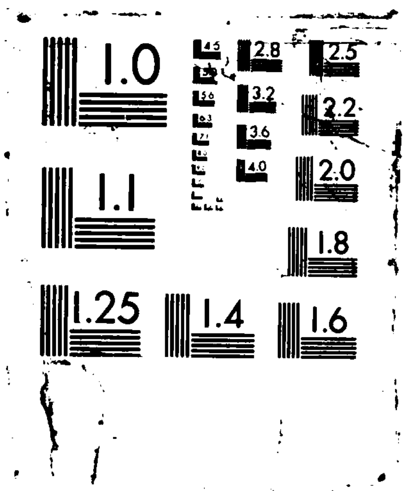
Sequence ID	Sequence Description	Considered for Further Analysis
VWXYZ001	A munitions vehicle collision/overturn occurs and crush forces fail the agent containment.	No
VWXYZ002	A munitions vehicle collision/overturn occurs and impact forces fail the agent containment.	No
VWXYZ003	A munitions vehicle collision/overturn occurs and puncture forces fail the agent containment.	Yes
VWXYZ005	A munitions vehicle accident with fire occurs, causing nonburstered munitions to fail.	No
VWXYZ006	An aircraft crashes on a munitions vehicle. No fire occurs; impact forces fail the agent containment.	Yes
VWXYZ007	An aircraft crashes on a munitions vehicle. Fire occurs, but impact forces fail the agent containment.	Yes
VWXYZ009	A severe earthquake occurs, causing a munitions vehicle accident and crush forces fail the agent containment.	No
VWXYZ010	A severe earthquake occurs, causing a munitions vehicle accident and impact forces fail the agent containment.	No
VWXYZ011	A severe earthquake occurs, causing a munitions vehicle accident and puncture forces fail the agent containment.	Yes
VWXYZ013	A severe earthquake occurs, causing a munitions vehicle accident and fire fails nonburstered munitions.	No
VWXYZ014	A tornado occurs, generating a missile or causing a truck overturn, and mechanical forces fail agent containment.	Yes

TRUCK TRANSPORT FROM SENDING SITE TO RECEIVING SITE - OFFSITE
AIR TRANSPORT ACCIDENT SEQUENCES

Sequence ID	Sequence Description	Considered for Further Analysis
VAXYZ001	A munitions vehicle collision/overturn occurs and crush forces fail the agent containment.	Yes
VAXYZ002	A munitions vehicle collision/overturn occurs and impact forces fail the agent containment.	Yes
VAXYZ003	A munitions vehicle collision/overturn occurs and puncture forces fail the agent containment.	Yes
VAXYZ004	Detonation of burstered munitions occurs by either (1) fire-only accident, (2) mechanical force and fire, (3) truck collision/overturn impact - induced rocket propellant ignition, or (4) truck collision/overturn - induced undue force detonation.	Yes
VAXYZ005	A munitions vehicle accident with fire occurs, causing nonburstered munitions to fail.	No
VAXYZ006	An aircraft crashes on a munitions vehicle. No fire occurs; impact forces fail the agent containment.	Yes
VAXYZ007	An aircraft crashes on a munitions vehicle. Fire occurs but impact forces fail the agent containment.	Yes
VAXYZ009	A severe earthquake occurs, causing a munitions vehicle accident and crush forces fail the agent containment.	Yes
VAXYZ010	A severe earthquake occurs, causing a munitions vehicle accident and impact forces fail the agent containment.	Yes
VAXYZ011	A severe earthquake occurs, causing a munitions vehicle accident and puncture forces fail the agent containment.	Yes
VAXYZ012	A severe earthquake occurs, causing a munitions vehicle accident and fire detonates burstered munitions.	Yes

AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO CA A W BARSELL ET AL. AUG 87 GA-C-18563

UNCLASSIFIED SAPEO-CDE-IS-87000 DAAA15-85-D-0022 F/G 15/6.3 NL


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

TRUCK TRANSPORT FROM SENDING SITE TO RECEIVING SITE - OFFSITE
AIR TRANSPORT ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
VAXYZ013	A severe earthquake occurs, causing a munitions vehicle accident and fire fails nonburstered munitions.	No
VAXYZ014	A tornado occurs, generating a missile or causing a truck overturn, and mechanical forces fail agent containment.	Yes
VAXYZ015	An earthquake or tornado occurs, generating undue mechanical forces which cause detonation of burstered munitions.	Yes

TRUCK TRANSPORT FROM SENDING SITE TO RECEIVING SITE - OFFSITE
RAIL TRANSPORT OPTION ACCIDENT SEQUENCES

Sequence ID	Sequence Description	Considered for Further Analysis
VRXYZ001	A munitions vehicle collision/overturn occurs and crush forces fail the agent containment.	No
VRXYZ002	A munitions vehicle collision/overturn occurs and impact forces fail the agent containment.	No
VRXYZ003	A munitions vehicle collision/overturn occurs and puncture forces fail the agent containment.	Yes
VRXYZ004	Detonation of burstered munitions occurs by either (1) fire-only accident, (2) mechanical force and fire, (3) truck collision/overturn impact-induced rocket propellant ignition, or (4) truck collision/overturn - induced undue force detonation.	Yes
VRXYZ005	A munitions vehicle accident with fire occurs, causing nonburstered munitions to fail.	No
VRXYZ006	An aircraft crashes on a munitions vehicle. No fire occurs; impact forces fail the agent containment.	Yes
VRXYZ007	An aircraft crashes on a munitions vehicle. Fire occurs but impact forces fail the agent containment.	Yes
VRXYZ009	A severe earthquake occurs, causing a munitions vehicle accident and crush forces fail the agent containment.	No
VRXYZ010	A severe earthquake occurs, causing a munitions vehicle accident and impact forces fail the agent containment.	No
VRXYZ011	A severe earthquake occurs, causing a munitions vehicle accident and puncture forces fail the agent containment.	Yes
VRXYZ012	A severe earthquake occurs, causing a munitions vehicle accident and fire detonates burstered munitions.	Yes

TRUCK TRANSPORT FROM SENDING SITE TO RECEIVING SITE - OFFSITE
RAIL TRANSPORT OPTION ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
VRXYZ013	A severe earthquake occurs, causing a munitions vehicle accident and fire fails nonburstered munitions.	Yes
VRXYZ014	A tornado occurs, generating a missile or causing a truck overturn, and mechanical forces fail agent containment.	Yes
VRXYZ015	An earthquake or tornado occurs, generating undue mechanical forces which cause detonation of burstered munitions.	Yes

OFFSITE HANDLING - SENDING SITES ACCIDENT SEQUENCES

Sequence ID	Sequence Description	Considered for Further Analysis
HC1 HA1 HW1	Drop of bare pallet or single item at storage area.	Yes
HC2 HA2 HW2	Forklift collision with short duration fire at storage area involving bare munitions.	Yes
HC3 HA3 HW3	Forklift tine accident at storage area involving bare munitions.	Yes
HC4 HA4 HW4	Forklift collision accident without fire at storage area involving bare munitions.	Yes
HC8 HA8 HW8	Drop of offsite container.	Yes
HC9 HA9 HW9	Collision accident with short duration fire during handling of offsite container.	Yes
HC10 HA10 HW10	Collision accident without fire during handling of offsite container.	Yes
HC11 HA11 HW11	Drop of bare palletized munition leads to detonation.	Yes
HC12 HA12 HW12	Forklift collision accident at storage area leads to detonation.	Yes
HC17 HA17 HW17	Drop of pallet containing a leaking munition during leaker isolation operations.	Yes
HC18 HA18 HW18	Drop of single leaking in leakers processing facility.	Yes

OFFSITE HANDLING - SENDING SITES ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
HC19 HA19 HW19	Forklift tine puncture during leaker isolation.	Yes
HC21 HA21 HW21	Collision accident without fire during handling of leaking munition.	Yes
HC23 HA23 HW23	Drop of munition in offsite container leads to detonation.	Yes
HC25 HA25 HW25	Collision accident during munition handling in offsite container leads to detonation.	Yes
HC27 HA27 HW27	Collision accident in offsite container with prolonged fire leads to thermal detonation.	Yes
HC29 HA29 HW29	Drop of pallet containing leaker leads to detonation.	Yes
HC30 HA30 HW30	Drop of single leaking munition leads to detonation.	Yes
HC31 HA31 HW31	Collision accident involving a leaking munition leads to detonation.	Yes
HC32 HA32 HW32	Failure to detect a leak in the offsite container.	Yes

OFFSITE HANDLING - RECEIVING SITES ACCIDENT SEQUENCES

Sequence ID	Sequence Description	Considered for Further Analysis
HC1 HA1 HW1	Drop of bare pallet or single item at storage area.	Yes
HC3 HA3 HW3	Forklift tine accident at storage area involving bare munitions.	Yes
HC4 HA4 HW4	Forklift collision accident without fire at storage area involving bare munitions.	Yes
HC5 HA5 HW5	Drop of onsite container.	Yes
HC6 HA6 HW6	Forklift collision accident with short duration fire during handling of onsite container.	Yes
HC7 HA7 HW7	Forklift collision without fire during handling of onsite container.	Yes
HC8 HA8 HW8	Drop of offsite container.	Yes
HC9 HA9 HW9	Collision accident with short duration fire during handling of offsite container.	Yes
HC10 HA10 HW10	Collision accident without fire during handling of offsite container.	Yes
HC11 HA11 HW11	Drop of bare palletized munition leads to detonation.	Yes
HC12 HA12 HW12	Forklift collision accident at storage area leads to detonation.	Yes

OFFSITE HANDLING - RECEIVING SITES ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
HC17 HA17 HW17	Drop of pallet containing a leaking munition during leaker isolation operations.	Yes
HC18 HA18 HW18	Drop of single leaking in leakers processing facility.	Yes
HC19 HA19 HW19	Forklift tine puncture during leaker isolation.	Yes
HC21 HA21 HW21	Collision accident without fire during handling of leaking munition.	Yes
HC22 HA22 HW22	Drop of munition in onsite container leads to detonation.	Yes
HC23 HA23 HW23	Drop of munition in offsite container leads to detonation.	Yes
HC24 HA24 HW24	Collision accident during munition handling in onsite container leads to detonation.	Yes
HC25 HA25 HW25	Collision accident during munition handling in offsite container leads to detonation.	Yes
HC26 HA26 HW26	Collision accident in onsite container with prolonged fire leads to thermal detonation.	Yes
HC27 HA27 HW27	Collision accident in offsite container with prolonged fire leads to thermal detonation.	Yes
HC29 HA29 HW29	Drop of pallet containing leaker leads to detonation.	Yes

OFFSITE HANDLING - RECEIVING SITES ACCIDENT SEQUENCES (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
HC30 HA30 HW30	Drop of single leaking munition leads to detonation.	Yes
HC31 HA31 HW31	Collision accident involving a leaking munition leads to detonation.	Yes
HC32 HA32 HW32	Failure to detect a leak in the offsite container.	Yes

FACILITY HANDLING ACCIDENT SEQUENCES

Sequence ID	Sequence Description	Considered for Further Analysis
HF1	Munition pallet or container dropped during movement from MHI to MDB.	Yes
HF2	Bare single munition dropped during handling inside the MDB.	Yes
HF3	Forklift collision accident with short duration fire during handling from MHI to MDB.	Yes
HF4	Forklift tine accident during handling from the MHI to MDB.	Yes
HF5	Collision accident with prolonged fire during handling from MHI to MDB leads to detonation or hydraulic rupture.	Yes
HF7	Collision accident without fire.	Yes
HF8	Munition dropped inside the MDB.	Yes
HF9	Forklift tine accident inside the MDB.	Yes
HF10	Collision without fire inside the MDB.	Yes
HF11	Drop of munition pallet from the MHI to MDB leads to detonation.	Yes
HF12	Drop of bare single munition inside the MDB leads to detonation.	Yes
HF13	Drop of palletized munition (in container) inside the MDB leads to detonation.	Yes
HF14	Collision accident from the MHI to the MDB leads to detonation.	Yes

PLANT OPERATIONS ACCIDENT SEQUENCES - EXTERNAL EVENTS

Sequence ID	Sequence Description	Considered for Further Analysis
P01	Tornado-generated missile puncture/crush munitions in the MHI.	Yes
P02	Tornado-generated missile detonate munitions in the MHI.	Yes
P03	Tornado-generated missile puncture/crush munitions in the UPA.	Yes
P04	Tornado-generated missile detonate munitions in the UPA.	Yes
P05	Tornado-generated missile damages the agent piping system between the BDS and TOX at TEAD (bulk-only facility).	Yes
P06	Meteorite strikes the MHI.	Yes
P07	Meteorite strikes the UPA.	Yes
P07A	Meteorite strikes the TOX.	Yes
P08	Meteorite strikes the agent piping system between the BDS and TOX at TEAD (bulk-only facility).	Yes
P09	Direct large aircraft crash onto the MHI; no fire.	Yes
P010	Direct large aircraft crash onto the MHI; fire not contained in 0.5 h.	Yes
P011	Direct large aircraft crash onto the MHI; fire contained in 0.5 h.	Yes
P012	Direct large aircraft crash damages the MDB; no fire.	Yes
P013	Direct large aircraft crash damages the MDB; fire not contained in 0.5 h.	Yes
P014	Direct large aircraft crash damages the MDB; fire contained in 0.5 h.	Yes
P015	Indirect large aircraft crash damages the MHI; no fire.	Yes

PLANT OPERATIONS ACCIDENT SEQUENCES - EXTERNAL EVENTS (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
P016	Indirect large aircraft crash damages the MHI; fire not contained in 0.5 h.	Yes
P017	Indirect large aircraft crash damages the MHI; fire contained in 0.5 h.	Yes
P018	Indirect large aircraft crash damages the MDB; no fire.	Yes
P019	Indirect large aircraft crash damages the MDB; fire not contained in 0.5 h.	Yes
P020	Indirect large aircraft crash damages the MDB; fire contained in 0.5 h.	Yes
P021	Direct crash of a large or small aircraft damages the outdoor agent piping system at TEAD; no fire.	Yes
P022	Direct crash of a large or small aircraft damages the outdoor agent piping system at TEAD; fire occurs and not contained.	Yes
P023	Earthquake causes the munitions in the MHI to fall and be punctured.[a]	No
P024	Earthquake causes munitions in the MHI to fall and detonate.[a]	No
P025	Earthquake damages the MDB structure, munitions fall and are punctured; fire suppressed.	Yes
P026	Earthquake damages the MDB structure, munitions fall and are punctured; earthquake also initiates fire; fire suppression system fails.	Yes
P028A[b]	Earthquake damages the MDB structure, munitions fall and are punctured; TOX damaged; fire occurs; fire suppressed.	No
P028	Earthquake damages the MDB structure, munitions fall and are punctured; TOX damaged; fire occurs; fire suppression system fails.	No
P029	Earthquake damages the MDB; munitions are intact; fire occurs; fire suppression system fails.	Yes

PLANT OPERATIONS ACCIDENT SEQUENCES - EXTERNAL EVENTS (Continued)

Sequence ID	Sequence Description	Considered for Further Analysis
P030	Earthquake damages the MDB; munitions are intact; TOX damaged; no fire occurs.[c]	No
P031A	Earthquake damages the MDB; munitions are intact; TOX damaged; fire occurs; fire suppressed.	No
P031	Earthquake damages the MDB; munitions are intact; TOX damaged; fire occurs; fire not suppressed.	No
P032	Earthquake causes munitions to fall and detonate; MDB breached by detonation; the TOX is intact; no fire.[c]	No
P033	Earthquake causes munitions to fall but no detonation occurs; the MDB is intact; the TOX is intact; earthquake also initiates fire; fire suppression system fails.	Yes
P034	Earthquake causes munitions to fall but no detonation occurs; the MDB is intact; the TOX is damaged; fire occurs; fire suppression system fails.	No

[a] Screened out due to design changes.

[b] Sequence 27 not used.

[c] Screened out on the basis of frequency.

ACCIDENTS FOR PLANT OPERATIONS - INTERNAL EVENTS

Sequence ID	Sequence Description	Considered for Further Analysis
P041	One munition falls off the conveyor in the ECV due to a process upset or improper loading and is punctured. The spill is not cleaned up in 1 h.	No
P042	One munition falls off the conveyor and detonates in the ECV, caused by process upset or improper loading.	Yes
P043	Same as P041 with added fire.	No
P044	Same as P042 with failure propagating to other munitions due to fragments.	No
P045	A process upset results in spill of agent inventory in ECR.	No
P046	Same as P045 with fire.	No
P047	Same as P045 with detonation.	No
P048	A punched munition falls off the BSA conveyor. Bulk drain station did not drain the munitions before sending it to the BSA, so that a spill occurs.	No
P049	Same as P048 with fire.	No
P050	Large spill (contents of agent collection tank) in TOX cubicle due to pipe failure (528 gal).	No
P051	Small spill (typically less than 50 gal) in TOX cubicle due to pipe failure.	No
P052	Same as P051 with fire.	No

Other sequences identified are summarized in Tables A-1, A-2, and A-3. These deal with furnace/incinerator events. The event trees corresponding to these sequences are in Section 7.1. None of the sequences in these tables was considered for detailed analysis.

TABLE A-1
EVENTS CONSIDERED FOR THE DEACTIVATION FURNACE SYSTEM

Event	Description
Stop munitions feed (DFS-SMF)	Failure on this event tree branch implies that feed of drained rockets or mines to the DFS is not discontinued, given that a shutdown signal occurs.
Ventilation system (DFS-VENT)	This branch point represents the failures of the ventilation system to provide filtered air to the DFS pump. (See Section 7.1 for the fault tree.)
Stop fuel (DFS-SFA)	Failure of this event tree branch implies that the natural gas supply line to the burner in the DFS retort is not isolated, given that a shutdown signal occurs. If ventilation to the room has failed, operator recovery is permitted to prevent a possible room explosion. (See Section 7.1 for the fault tree.)
Explosion does not occur (DFS-EXP)	Failure of this branch implies that a natural gas explosion has occurred in the DFS room. For the situation in which ventilation succeeds, the size of this explosion is the size of a DFS furnace explosion. For the case in which room ventilation has failed, the explosion is the size of a DFS room explosion. The probability was subjectively estimated.
Explosion contained (DFS-CONT)	Failure of this branch implies that the DFS room structure has been breached by an explosion. The probability was subjectively estimated.

TABLE A-2
EVENTS CONSIDERED FOR THE LIQUID INCINERATOR (LIC)

Event	Description
Ventilation system (LIC-VENT)	This branch point represents the failure of the ventilation system to provide air to the LIC room. (The fault tree is in Section 7.1.)
Stop agent feed (LIC-SAF)	This branch point represents both the ACS and the operator failing to shut off the agent feed and failing to recognize that the feed is not shut off. Different time periods and therefore different recovery probabilities apply for different scenarios. (The fault tree is in Section 7.1.)
Shutdown PAS (LIC-SPAS)	This branch point represents both the ACS and the operator failing to stop flow through the PAS and failing to recognize that flow continues. (The fault tree is in Section 7.1.)
Stop fuel to burners (LIC-SFF)	The branch point represents both the ACS and the operator failing to shut off the fuel within 15 min and failing to recognize that the fuel is not shut off. This event applies to the PCC and the AB. (The fault tree is in Section 7.1.)
Avoid explosion (LIC-EXP)	This branch represents ignition/detonation of accumulated fuel/air or agent/air mixtures. The probability was subjectively assigned.
Structure contains explosion (LIC-CONT)	This branch represents failure of the LIC room to contain an explosion. The probability was subjectively assigned.
Stop fuel to LIC-PCC burner (LIC-SFP)	This branch point represents both the ACS and the operator failing to shut off fuel to the LIC PCC burner within 15 min and failing to recognize that the fuel is not shut off. (The fault tree is in Section 7.1.)

TABLE A-3
EVENTS CONSIDERED FOR THE METALS PARTS FURNACE (MPF)

Event	Description
<u>MPF-1 Tree</u>	
Ventilation System (MPF-VENT)	This branch point represents the failure of the exhaust system to provide filtered air to the MPF room. (See Section 7.1 for the fault tree.)
Stop fuel (MPF-SFA)	Failure of the branch point implies that the natural gas supply to one or more burners in the MPF has not been isolated. If room ventilation has failed, operator recovery is permitted to prevent a possible room explosion. (See Section 7.1 for the fault tree.)
Explosion avoided (MPF-EXP)	Failure of this branch point implies that natural gas explosion has occurred in the MPF room. For this situation in which ventilation succeeds, the size of the explosion is the size of the DFS furnace explosion. For the case in which room ventilation has failed, the explosion is the size of an MPF room explosion. The probability was subjectively estimated.
Explosion contained (MPF-CONT)	Failure of this branch point implies that the MPF room structure has been breached by the MPF explosion. The probability was subjectively estimated.
<u>MPF-2 Tree</u>	
Explosion does not occur (MPF-EX)	This branch point involves the undrained munition exploding in the MPF. The probability was subjectively estimated.
MPF room and vent integrity maintained (MPF-INT)	This branch point involves damage to the MPF room or vent such that agent in the room is released to the atmosphere. The probability was subjectively estimated.

APPENDIX B
SENSITIVITY ANALYSIS

3.0 INTRODUCTION

Several accident scenarios were identified that could result in a significant release of agent to the environment during demilitarization operations at CONUS sites. These scenarios include:

- TOX Area Fire
- BSA Area Fire
- ECV Area Fire
- Carbon Filter Fire
- Carbon Filter Desorption
- Continued Agent Feed in Non-operating LIC
- PAS Agent Scrubbing
- Feed Full Ton Container into MPF.

Several other scenarios involving munition detonation were identified but not evaluated in favor of providing documentation for the sensitivity analyses. Results from the sensitivity analysis are described for each scenario as follows.

3.1 Results from Sensitivity Analyses

3.1.1 TOX Area Fire. The TOX Area fire involves the following sequence of events:

(1) Rupture of filled 1300-gallon agent storage tank in TOX Area
(2) Ignition of agent spill
(3) Failure of TOX fire suppression system
(4) Fire vaporizes agent which is vented from the TOX to the carbon filters.

Undecomposed agent can be released to the environment through the filters if the agent flow rate is sufficiently high, the filters approach saturation and/or the filter inlet gas temperature is high. The sensitivity

of the magnitude of agent released to the environment was therefore considered on the following variables:

- Residence time of volatilized agent in the TOX
- Fire size (directly related to undecomposed agent flow rate)
- Combustion efficiency (directly related to undecomposed agent flow rate)
- Capacity of carbon to absorb agent
- Gas temperature at filter inlet.

In an agent fire, heat returned to the pool of burning liquid by convective and radiative mechanisms is used to volatilize agent. Part of the volatilized agent is combusted with the remainder potentially vented from the area. Residence time in the TOX of volatilized agent that is not combusted was included in the sensitivity analysis because the fire may raise the temperature to a point where thermal decomposition of the volatilized agent could occur. As a worst case, a 1-second residence time was assumed. This is equivalent to the volatilized agent traveling a distance of about four inches prior to entering the TOX ventilation exhaust duct. Residence times of 2, 5, 10, and 14.3 seconds were also evaluated. The 14.3-second residence time is the most credible case and would involve a fire on the floor directly below the exhaust duct (5-feet above the floor). This is possible because a 1300-gallon spill of agent will fill the 500-gallon sump in the TOX and completely cover the TOX floor.

As discussed in detail in the calculation summaries given in Appendix A pages A1 through A28, the fire size will be limited by the ventilation flow rate. The worst case, i.e. the largest fire, will result when the fire burns a sufficient amount of agent to reduce the oxygen concentration to the minimum level required for combustion. A second case involves a fire size equivalent to the TOX sump area. Another fire size is where the release of undecomposed agent from the TOX area reaches a maximum for a particular residence time. This fire size, calculated by trial and error, is where the agent vaporization rate is relatively high while the agent combustion rate and, in turn, the TOX temperature is sufficiently low such that thermal decomposition of agent is not appreciable.

The combustion efficiencies evaluated were 50, 75 and 100 percent. It is important to note that a 100 percent combustion efficiency implies that all the agent involved in combustion is converted to CO_2, H_2O, P_2O_5, etc. so that the entire heating value of the agent is generated. A combustion efficiency of less than 100 percent implies that intermediate combustion products formed so that the entire heating value of the agent was not generated. Agent can be volatilized but not combusted for any combustion efficiency including 100 percent. This could occur if the part of the agent is directed away from the flames as it is volatilized.

The capacity of the carbon to adsorb agent was varied from 0.05 lb agent/lb carbon as a worst case to 0.2 lb agent/lb carbon. The 0.2 lb capacity is still conservative when compared with the capacities of 0.37 lb HD/lb carbon, 0.298 lb VX/lb carbon, and 0.318 lb GB/lb carbon given in Reference 1. These capacities are for G210 coconut-derived, non-whetlerized activated carbon, which is similar to the activated carbon used at CAMDS.

The gas temperature at the filter inlet was varied from 100 F up to a temperature calculated from heat balances. The calculated temperature is the worst case because it does not incorporate all heat losses from the gas during traversal between the TOX Area and the filters. The rate and degree of adsorption is known to be exponentially and inversely proportional to temperature. Thus, a small increase in temperature may cause a significant decrease in adsorption efficiency.

Table 1 gives a summary of agent releases for various fire sizes and combustion efficiencies. The maximum fire duration given in Table 1 was estimated as follows. The maximum fire duration for large fires which reduce the oxygen concentration in the TOX to the minimum required for combustion is the time required for an operator to close the inlet dampers to the TOX, thereby shutting off the oxygen supply. As shown in Figure 1, approximately 15 minutes are required for a 99 percent probability that an operator will respond to close the TOX inlet dampers. This includes a 5 minute period in which the operator will attempt to start the fire protection system in the TOX. In cases where the fire size is not at a maximum, additional time is required for consumption of the oxygen remaining in the TOX after the dampers are shut. The fire will continue until the

TABLE 1. SUMMARY OF TOX AREA FIRE CALCULATIONS[a]

Fire Size and Combustion Efficiency are Varied

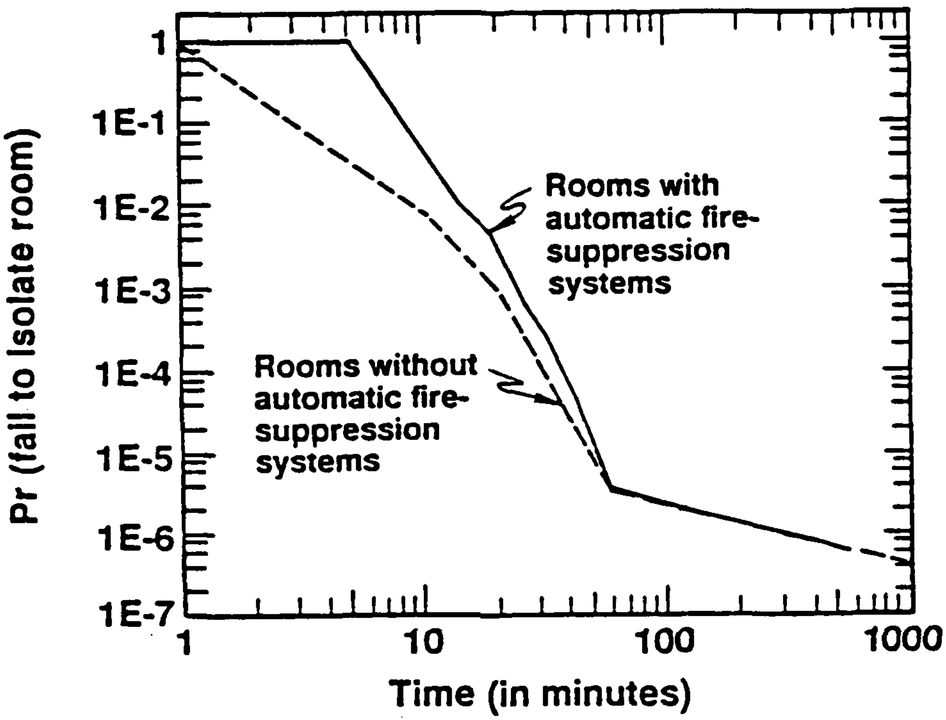
Agent	Fire Size (sq. ft.)	Combustion Efficiency (%)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	Sump[b]	100	2	0.0092	0.1959	22
HD	60	100	(c)	< 0.0001	< 0.0001	15
HD	Sump	75	4	0.0020	0.2103	25
HD(d)	21	75	4	0.0028	0.2814	25
HD	80	75	(c)	< 0.0001	< 0.0001	15
HD	Sump	50	34	< 0.0001	0.0009	33
HD	121	50	(c)	< 0.0001	< 0.0001	15
GB	Sump	100	3	0.0630	2.7654	20
GB	51	100	(c)	< 0.0001	< 0.0001	15
GB	Sump	75	5	0.0167	6.2820	24
GB(d)	21	75	2	0.0229	6.4324	23
GB	68	75	(c)	< 0.0001	< 0.0001	15
GB	Sump	50	10	0.0002	0.6728	30
GB	103	50	(c)	< 0.0001	< 0.0001	15
VX	Sump	100	(c)	< 0.0001	< 0.0001	15
VX	21	100	(c)	< 0.0001	< 0.0001	15
VX(d)	14	75	> 60	< 0.0001	< 0.0001	18
VX	Sump	75	> 60	< 0.0001	< 0.0001	16
VX	28	75	(c)	< 0.0001	< 0.0001	15
VX	Sump	50	(c)	< 0.0001	< 0.0001	19
VX	42	50	(c)	< 0.0001	< 0.0001	15

(a) Carbon capacity = 0.05 lb agent/lb carbon, gas temperature at filter inlet calculated from heat balances. The residence time of the fire products in the TOX area = 1 second.

(b) Sump area = 20 square feet.

(c) The fire does not release agent from the TOX area.

(d) Worst-case fire area/combustion efficiency combination.



Time	Pr (fail to isolate by X mins)	
	With System	Without System
by 5 mins.	1.0	4E-2
by 10 mins.	4E-2	1E-2
by 15 mins.	1E-2	4E-3

Figure 1. Operator Times Versus Probabilities for Failure to Close Dampers

minimum oxygen level required for combustion is reached, at which point the fire is assumed to self-extinguish.

Results indicate that both fire size and combustion efficiency have a significant effect on the magnitude of agent released to the environment. The worst cases are 75 percent combustion efficiency/21 sq. ft. fire for HD and for GB. No combination of the variables allowed a significant release of VX.

Table 2 gives a summary of agent releases for various gas residence times in the TOX. The most credible residence time of 14.3 seconds results in a significantly lower agent release. The 14/75 fire size/combustion efficiency combination is the worst case for a 14.3-second residence time. This trend is explained later for the BSA area fire.

Table 3 gives a summary of agent releases for variable carbon capacities. The more credible capacity of 0.2 lb agent/lb carbon significantly reduced the amount of agent released by at least an order of magnitude.

Table 4 gives a summary of agent releases for variable gas temperatures at the filter inlet. The lower temperatures resulted in significantly lower agent releases due to the strong dependence of the adsorption rate constant on temperature.

The worst-case and most-credible-case agent releases for the TOX Area fire are given in Table 5. The most credible case was selected based on a 14.3-second residence time for the volatilized agent in the TOX, a carbon capacity of 0.05 lb agent/lb carbon (worst case), filter inlet gas temperature calculated from heat balances (worst case), and the worst case fire size/combustion efficiency combination. The worst case was as above except for a 1-second residence time. The most credible case is still very conservative because:

- The selected agent capacity of carbon is below that obtained during actual agent tests
- Filter bank inlet gas temperature will be lower than the calculated temperature when all heat losses are taken into account
- As described in the calculation summary of Appendix A, worst-case assumptions were used whenever information was unavailable.

TABLE 2. SUMMARY OF TOX AREA FIRE CALCULATIONS[a]

Residence Time of Fire Products in TOX Varied

Agent	Fire Size/ Combustion Efficiency (sq. ft./%)	Residence Time (sec.)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	20/75	1	2	0.0092	0.1959	25
HD	20/75	2	5	0.0015	0.1168	25
HD	20/75	5	7	0.0006	0.0291	25
HD	20/75	10	12	0.0002	0.0059	25
HD[b]	20/75	14.3	19	< 0.0001	0.0021	25
HD[b]	14/75	14.3	21	< 0.0001	0.0056	31
GB	21/75	1	2	0.0229	6.4324	23
GB	21/75	2	2	0.0151	2.8776	23
GB	21/75	5	3	0.0053	0.4355	23
GB	21/75	10	5	0.0014	0.0581	23
GB[b]	21/75	14.3	7	0.0005	0.0176	23
GB[b]	14/75	14.3	9	0.0002	0.1613	29
VX	14/75	1	> 60	< 0.0001	< 0.0001	18
VX	14/75	2	> 60	< 0.0001	< 0.0001	18
VX	14/75	5	> 60	< 0.0001	< 0.0001	18
VX	14/75	10	> 60	< 0.0001	< 0.0001	18
VX[b]	14/75	14.3	> 60	< 0.0001	< 0.0001	18
VX(b)	10/75	14.3	> 60	< 0.0001	< 0.0001	21

(a) Carbon capacity = 0.05 lb agent/lb carbon. The filter inlet gas temperature calculated by heat balances. Worst case fire size/combustion efficiency combinations shown for GB and VX.

(b) Most credible residence time of the fire products in the TOX area.

TABLE 3. SUMMARY OF TOX AREA FIRE CALCULATIONS[a]

Carbon Capacity Varied

Agent	Fire Size/ Combustion Efficiency (sq. ft./%)	Carbon Capacity (lb agent/ lb carbon)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	21/75	0.2	4	0.0016	0.0214	25
HD	21/75	0.05	4	0.0028	0.2814	25
HD[b]	14/75	0.2	50	< 0.0001	0.0004	31
HD[b]	14/75	0.05	21	< 0.0001	0.0050	31
GB	21/75	0.2	2	< 0.0097	0.1452	23
GB	21/75	0.05	2	0.0229	6.4324	23
GB[b]	14/75	0.2	5	0.0001	0.0025	29
GB[b]	14/75	0.05	9	0.0002	0.1613	29
VX	14/75	0.2	> 60	< 0.0001	< 0.0001	18
VX	14/75	0.05	> 60	< 0.0001	< 0.0001	18
VX[b]	14/75	0.2	> 60	< 0.0001	< 0.0001	21
VX[b]	14/75	0.05	> 60	< 0.0001	< 0.0001	21

(a) Gas temperature at filter inlet calculated from heat balances. The residence time of the fire products in the TOX area = one second. Worst-case fire size/combustion efficiency combinations shown.

(b) Gas temperature at filter inlet calculated from heat balances. The residence time of the fire products in the TOX area = 14.3 seconds. Worst-case fire size/combustion efficiency combinations shown.

TABLE 4. SUMMARY OF TOX AREA FIRE CALCULATIONS[(a)]

Filter Inlet Gas Temperature Varied

Agent	Fire Size/ Combustion Efficiency (sq. ft./%)	Filter Inlet Gas Temperature (F)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	21/75	100	18	< 0.0001	0.0092	25
HD	21/75	114	4	< 0.0028	0.2814	25
HD[(b)]	14/75	100	32	< 0.0001	0.0009	31
HD[(b)]	14/75	105	21	< 0.0001	0.0050	31
GB	21/75	100	9	0.0001	0.0062	23
GB	21/75	116	2	0.0229	6.4324	23
GB[(b)]	14/75	100	17	< 0.0001	0.0385	29
GB[(b)]	14/75	106	9	0.0002	0.1613	29
VX	14/75	100	> 60	< 0.0001	< 0.0001	18
VX	14/75	126	> 60	< 0.0001	< 0.0001	18
VX[(b)]	14/75	100	> 60	< 0.0001	< 0.0001	21
VX[(b)]	14/75	126	> 60	< 0.0001	< 0.0001	21

(a) Carbon capacity = 0.05 lb agent/lb carbon. The residence time of the fire products in the TOX area = 1 second. Worst-case fire size/combustion efficiency combinations shown.

(b) Carbon capacity = 0.05 lb agent/lb carbon. The residence time of the fire products in the TOX area = 14.3 seconds. Worst-case fire size/combustion efficiency combinations shown.

TABLE 5. TOX AREA FIRE WORST CASE/MOST CREDIBLE CASE AGENT RELEASES

WORST CASE (a)

Agent	Fire Size (sq. ft.)	Combustion Efficiency (%)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	21	75	4	0.0028	0.2814	25
GB	21	75	2	0.0229	0.4324	23
VX	14	75	> 60	< 0.0001	< 0.0001	17

MOST CREDIBLE CASE (b)

Agent	Fire Size (sq. ft.)	Combustion Efficiency (%)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	14	75	21	< 0.0001	0.0050	31
GB	14	75	9	0.0002	0.1613	29
VX	10	75	> 60	< 0.0001	< 0.0001	21

(a) Carbon capacity = 0.05 lb agent/lb carbon, filter inlet gas temperature calculated from heat balance. The residence time of the fire products in the TOX area = 1 second.

(b) Carbon capacity = 0.05 lb agent/lb carbon, filter inlet gas temperature calculated from heat balance. The residence time of the fire products in the TOX area = 14.3 seconds. Worst-case fire size/combustion efficiency used.

It is important to note that a spill significantly less than 500 gallons can cause the worst-case or most-credible-case agent releases to be achieved because the fire areas for these events are approximately the same as or less than the TOX sump area of 20 sq. ft.

3.1.2 BSA Area Fire. The BSA Area fire involves the following sequence of events:

(1) Contents of a filled ton container are spilled on the floor in the Buffer Storage Area.

(2) Spilled agent is ignited.

(3) Fire vaporizes agent, which is vented from the BSA to the carbon filters.

The variables described in the TOX Area fire were evaluated for the BSA Area fire. A summary of the calculations is given in Appendix A, pages A29 through A35.

Table 6 gives a summary of agent releases during a BSA fire for various fire sizes and combustion efficiencies. The size of an agent release is most dependent on fire size. Although large fires resulted in large rates of undecomposed agent being generated, the resultant temperature in the BSA (over 1000 F in some cases) would cause significant thermal decomposition of the agent. However, in some cases the high rate of undecomposed agent being expelled from the TOX could overwhelm the carbon filters due to limitations in the adsorption kinetics. Combustion efficiency had a significant effect on agent release for all cases, with the worst case being a 100 percent combustion efficiency. The much larger agent releases in the BSA Area as compared with the TOX Area are due to the availability of more ventilation air in the BSA, thereby allowing combustion and volatilization of agent at a more rapid rate.

Table 7 gives a summary of agent releases during a BSA fire for various residence times of fire products in the BSA. The most credible residence time of 35.6 seconds is equivalent to a fire directly beneath the BSA exhaust duct. A worst-case residence time was assumed to be 1 second.

For a particular residence time, the agent released is dependent upon fire size. As shown in Figure 2, the amount of agent released

TABLE 6. SUMMARY OF BSA AREA FIRE CALCULATIONS (TON CONTAINER)[(a)]

Fire Size and Combustion Efficiency are Varied

Agent	Fire Size (sq. ft.)	Combustion Efficiency (%)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	Sump[(b)]	100	> 60	< 0.0001	0.0004	62
HD[(g)]	10	100	1	13.8317	75.2400	19
HD	77	100	(d)	< 0.0001	< 0.0001	(c)
HD	Sump	75	(d)	< 0.0001	< 0.0001	80
HD	103	75	(d)	< 0.0001	< 0.0001	(c)
HD	Sump	50	(d)	< 0.0001	< 0.0001	127
HD	156	50	(d)	< 0.0001	< 0.0001	(e)
GB	Sump	100	3	0.0050	0.3593	60
GB[(g)]	10	100	1	29.8980	160.7580	19
GB	66	100	(d)	< 0.0001	< 0.0001	(e)
GB	Sump	75	> 60	< 0.0001	< 0.001	78
GB	89	75	(d)	< 0.0001	< 0.0001	(e)
GB	Sump	50	> 60	< 0.0001	< 0.001	119
GB	135	50	(d)	< 0.0001	< 0.0001	(f)
VX	Sump	100	> 60	< 0.0001	< 0.0001	30
VX[(g)]	11	100	3	0.0130	0.1391	16
VX	26	100	(d)	< 0.0001	< 0.0001	10
VX	Sump	75	(d)	< 0.0001	< 0.0001	43
VX	36	75	(d)	< 0.0001	< 0.0001	10
VX	Sump	50	(d)	< 0.0001	< 0.0001	79
VX	54	50	(d)	< 0.0001	< 0.0001	10

(a) Carbon capacity = 0.05 lb agent/lb carbon, gas temperature at filter inlet calculated from heat balances. The residence time of the fire products in the BSA area = 1 second.
(b) Sump area = 4 square feet.
(c) The fire burns to completion within 8 minutes.
(d) The fire does not release agent from the BSA area.
(e) The fire burns to completion within 7 minutes.
(f) The fire burns to completion within 6 minutes.
(g) Worst-case fire area/combustion efficiency combination.

TABLE 7. SUMMARY OF BSA AREA FIRE CALCULATIONS (TON CONTAINER)[a]

Residence Time of Fire Products in BSA Varied

Agent	Fire Size/ Combustion Efficiency (sq. ft./%)	Residence Time (sec.)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	18/100	1	1	13.8317	75.2400	19
HD	18/100	2	1	10.0869	53.5405	19
HD	18/100	5	1	5.1578	20.6459	19
HD	18/100	10	1	0.9675	4.7516	19
HD	18/100	35.6	7	0.0007	0.0035	19
HD	10/100	35.6	1	0.4758	6.8254	29
GB	18/100	1	1	29.8980	168.7586	19
GB	18/100	2	1	23.9972	133.3433	19
GB	18/100	5	1	12.7504	68.0816	19
GB	18/100	10	1	4.7153	24.2035	19
GB	18/100	35.6	1	0.0382	0.1903	19
GB	11/100	35.6	1	2.2634	28.8833	26
VX	11/100	1	3	0.0138	0.1391	16
VX	11/100	2	3	0.0101	0.0941	16
VX	11/100	5	3	0.0044	0.0350	16
VX	11/100	10	5	0.0013	0.0092	16
VX	11/100	35.6	> 60	< 0.0001	< 0.0001	16
VX	7/100	35.6	> 60	< 0.0001	< 0.0001	20

(a) Carbon capacity = 0.05 lb agent/lb carbon. The filter inlet gas temperature calculated from heat balances. Worst-case fire size/combustion efficiency combinations shown.

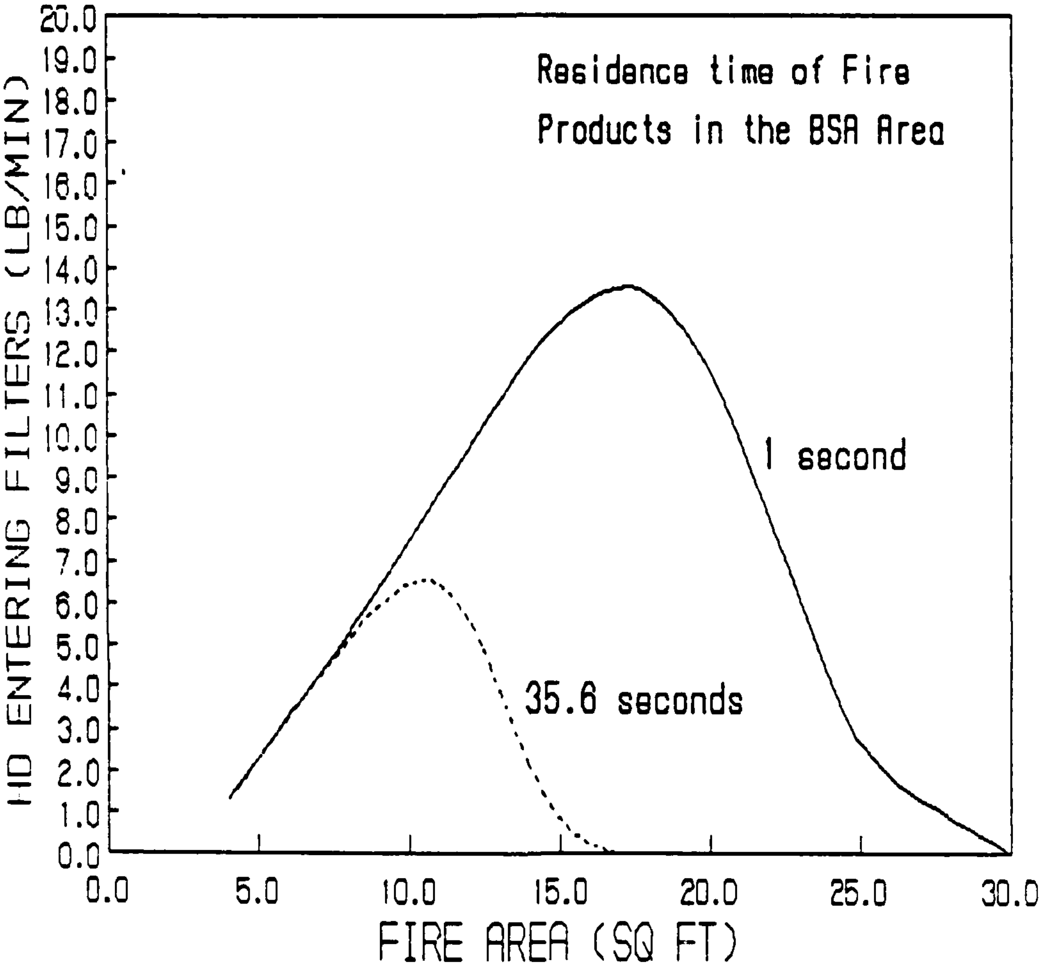


Figure 2. Effect of Residence Time on Maximum Quantity of Agent Entering Filters during the BSA Fire

increases as the fire size increases, reaches a maximum, and then falls to zero. As the fire size is increased the amount of volatilized agent that is not combusted increases in proportion to the fire size. However, increasing the fire size causes the temperature in the area of the fire to increase such that thermal decomposition becomes significant. Because thermal decomposition is exponentially related to fire size through temperature, the amount of undecomposed agent decreases as the fire size increases. These trends are illustrated in Figure 3.

The fire size which gives the maximum agent release decreases as the residence time increases, as shown in Figure 2. This is because as the residence time is increased the amount of undecomposed agent released decreases for a particular fire size. Thus, smaller fires which result in a lower temperature and hence, lower degree of thermal decomposition, would favor generation of more undecomposed agent than larger fires. It is important to note that the worst-case fire size/combustion efficiency was calculated by trial and error for each worst-case and most-credible-case residence time for the TOX, BSA and ECV fire scenarios.

Table 8 gives a summary of agent release during a BSA fire for various carbon capacities. The carbon capacity has only a slight effect on the amount of agent released within the range of capacities evaluated. This is because the high temperature of the gases entering the filters makes adsorption unfavorable.

Table 9 gives a summary of agent releases during a BSA fire for various gas temperature at the filter inlet. The lower gas temperature had a significant effect on agent release amounting to a reduction of between three and five orders of magnitude.

The worst-case and most-credible-case agent releases for the BSA Area fire scenarios are given in Table 10. The most credible case was based on a 35.6-second residence time for the volatilized agent in the BSA, a carbon capacity of 0.05 lb agent/lb carbon (worst case), a filter inlet gas temperature calculated from heat balances (worst case), and the worst-case fire size/combustion efficiency combination. The worst case is as above except for a 1-second residence time. The most credible case is still very conservative for similar reasons to those given in the TOX area fire section.

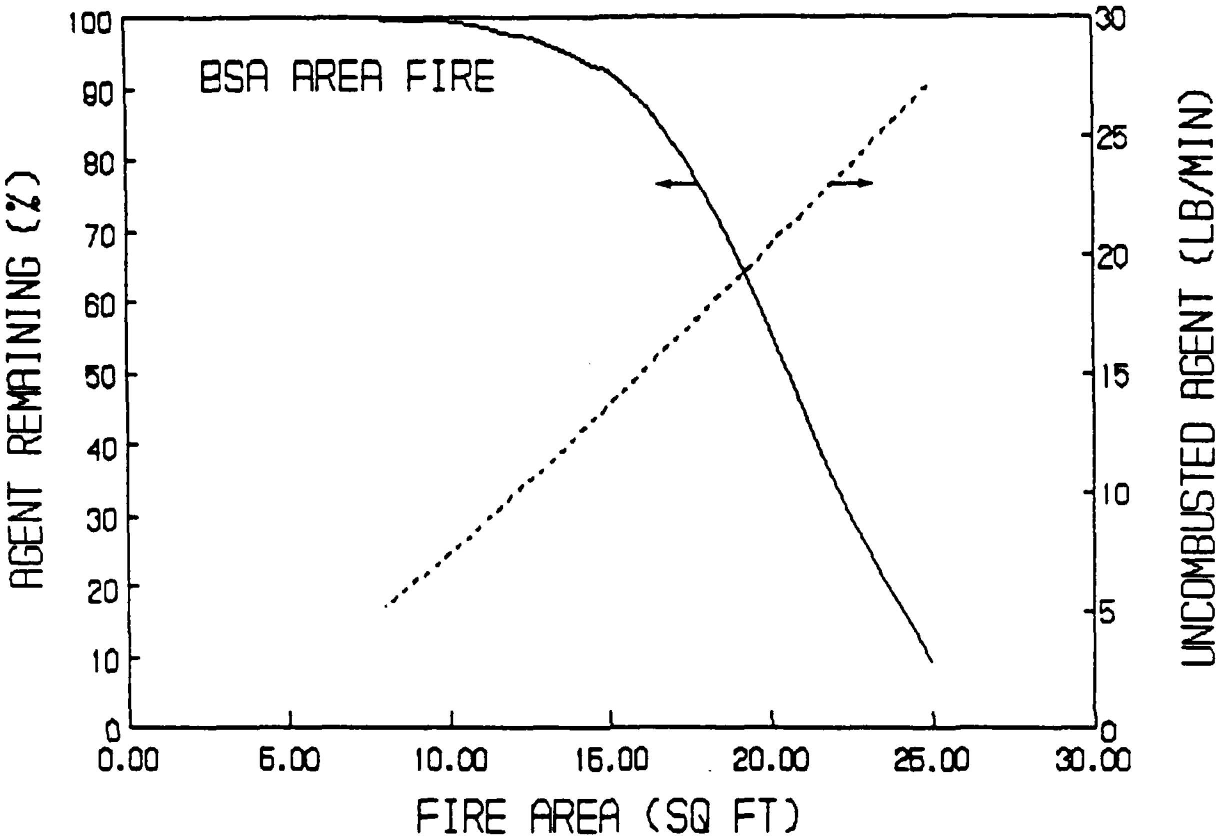


Figure 3. Variance of Thermal Decomposition of Agent and Generation Rate of Undecomposed Agent with Fire Area for the BSA Fire

TABLE 8. SUMMARY OF BSA AREA FIRE CALCULATIONS (TON CONTAINER)[(a)]

Carbon Capacity Varied

Agent	Fire Size/ Combustion Efficiency (sq. ft./%)	Carbon Capacity (lb agent/ lb carbon)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	18/100	0.2	1	12.7931	61.2925	19
HD	18/100	0.05	1	13.8317	75.2400	19
HD [(b)]	10/100	0.2	1	0.4213	3.9503	29
HD [(b)]	10/100	0.05	1	0.4758	6.8254	29
GB	18/100	0.2	1	26.8097	128.6018	19
GB	18/100	0.05	1	29.8980	168.7586	19
GB [(b)]	11/100	0.2	1	1.9434	15.7784	26
GB [(b)]	11/100	0.05	1	2.2634	28.8833	26
VX	11/100	0.2	3	0.0103	0.0666	16
VX	11/100	0.05	3	0.0138	0.1391	16
VX [(b)]	7/100	0.2	> 60	< 0.0001	< 0.0001	20
VX [(b)]	7/100	0.05	> 60	< 0.0001	< 0.0001	20

(a) Gas temperature at filter inlet calculated from heat balances. The residence time of the fire products in the BSA area = 1 second. Worst-case fire size/combustion efficiency combinations shown.

(b) Same as in (a) except the residence time of the fire production in the BSA area = 35.6 seconds.

TABLE 9. SUMMARY OF BSA AREA FIRE CALCULATIONS (TON CONTAINER)[a]

Filter Inlet Gas Temperature Varied

Agent	Fire Size/ Combustion Efficiency (sq. ft./%)	Filter Inlet Gas Temperature (F)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	10/100	100	14	< 0.0001	0.0074	19
HD	10/100	179	1	13.8317	75.2400	19
HD [b]	10/100	100	30	< 0.0001	0.0009	29
HD [b]	10/100	143	1	0.4750	6.8254	29
GB	10/100	100	7	0.0003	0.6973	19
GB	10/100	183	1	29.8980	168.7586	19
GB [b]	11/100	100	17	< 0.0001	0.0144	26
GB [b]	11/100	152	1	2.2034	28.8833	26
VX	11/100	100	> 60	< 0.0001	< 0.0001	16
VX	11/100	208	3	0.0130	0.1391	16
VX [b]	7/100	100	> 60	< 0.0001	< 0.0001	20
VX [b]	7/100	174	> 60	< 0.0001	< 0.0001	20

(a) Carbon capacity = 0.05 lb agent/lb carbon. The residence time of the fire products in the BSA area = 1 second Worst-case fire size/combustion efficiency combinations shown.

(b) Same as in (a) except the residence time of the fire products in the BSA area = 35.6 seconds.

TABLE 10. BSA AREA FIRE WORST CASE/MOST CREDIBLE CASE AGENT RELEASES

WORST CASE (a)

Agent	Fire Size (sq. ft.)	Combustion Efficiency (%)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	18	100	1	13.8317	75.2400	19
GB	18	100	1	29.8980	168.7586	19
VX	11	100	3	0.0138	0.1391	16

MOST CREDIBLE CASE (b)

Agent	Fire Size (sq. ft.)	Combustion Efficiency (%)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	10	100	1	0.4768	6.8254	29
GB	11	100	1	2.2634	28.8833	26
VX	7	100	> 60	< 0.0001	< 0.0001	20

(a) Carbon capacity = 0.05 lb agent/lb carbon, filter inlet gas temperature calculated from heat balances. The residence time of the fire products in the BSA area = 1 second.

(b) Carbon capacity = 0.05 lb agent/lb carbon, filter inlet gas temperature calculated from heat balances. The residence time of the fire products in the BSA area = 35.6 seconds.

It is important to note that the worst-case agent release would involve a TC that gradually leaks agent rather than a ruptured TC that spills the entire contents at once. The size of the fire following ignition of spilled agent from a leaking TC may be at the worst-case conditions depending upon the leak rate and spill configuration. However, ignition of the spill from a ruptured TC would probably cause an initial large fire that, because of thermal decomposition, releases an insignificant amount of agent to the environment. This large fire would rapidly consume agent and decrease in size until it is restricted to the sump at which time low levels of agent would be released to the environment. The fire would rapidly pass through the zone where large amounts of undecomposed agent are generated. As an approximation, agent released from a fire in the case of a ruptured TC can be taken as being equivalent to a sump fire for the entire fire duration.

<u>3.1.3 ECV Area Fire</u>. The ECV Area fire involves the following sequence of events:

(1) Contents of a filled ton container are spilled on the floor in the Explosive Containment Vestibule. The location assumed is given in Appendix A.

(2) Spilled agent is ignited.

(3) Fire vaporizes agent which is vented from the ECV area to the carbon filters.

The variables described in the TOX area fire were evaluated for the ECV area fire. A summary of the calculations is given in Appendix A, pages A36 through A41.

Table 11 gives a summary of agent releases during an ECV fire for varying fire size and combustion efficiency. As in the case of the BSA Area fire, both the fire size and combustion efficiency have a significant effect on the amount of agent released. The worst cases are 100 percent combustion efficiency/11 sq. ft. fire size for HD and GB. No significant VX releases were observed for any combination of fire size and combustion efficiency.

Table 12 gives a summary of agent releases during an ECV fire for various residence times of volatilized agent in the ECV. The most credible

TABLE 11. SUMMARY OF ECV AREA FIRE CALCULATIONS (TON CONTAINER)[a]

Fire Size and Combustion Efficiency Varied

Agent	Fire Size (sq. ft.)	Combustion Efficiency (%)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	Sump[b]	100	> 60	< 0.0001	< 0.0001	30
HD[c]	11	100	4	0.0022	0.0208	16
HD	40	100	(e)	< 0.0001	< 0.0001	10
HD	Sump	75	> 60	< 0.0001	< 0.0001	39
HD	64	75	(e)	< 0.0001	< 0.0001	10
HD	Sump	50	> 60	< 0.0001	< 0.0001	69
HD	90	50	(e)	< 0.0001	< 0.0001	10
GB	Sump	100	> 60	< 0.0001	< 0.0001	30
GB[c]	11	100	2	0.0118	0.1780	16
GB	41	100	(e)	< 0.0001	< 0.0001	10
GB	Sump	75	> 60	< 0.0001	< 0.0001	37
GB	55	75	(e)	< 0.0001	< 0.0001	10
GB	Sump	50	> 60	< 0.0001	< 0.0001	53
GB	84	50	(e)	< 0.0001	< 0.0001	(d)
VX	Sump	100	> 60	< 0.0001	< 0.0001	10
VX[c]	7	100	> 60	< 0.0001	< 0.0001	14
VX	17	100	(e)	< 0.0001	< 0.0001	10
VX	Sump	75	> 60	< 0.0001	< 0.0001	23
VX	22	75	(e)	< 0.0001	< 0.0001	10
VX	Sump	50	> 60	< 0.0001	< 0.0001	37
VX	34	50	(e)	< 0.0001	< 0.0001	10

(a) Carbon capacity = 0.05 lb agent/lb carbon, gas temperature at filter inlet calculated from heat balances. The residence time of the fire products in the ECV area = 1 second.

(b) Sump area = 4 square feet.

(c) Worst-case fire size/combustion efficiency combination.

(d) The fire burns to completion within 10 minutes.

(e) The fire does not release agent from the ECV area.

TABLE 12. SUMMARY OF ECV AREA FIRE CALCULATIONS (TON CONTAINER)[a]

Residence Time of Fire Products in ECV Varied

Agent	Fire Size/ Combustion Efficiency (sq. ft./%)	Residence Time (sec.)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	11/100	1	4	< 0.0022	0.0208	16
HD	11/100	2	5	0.0014	0.0116	16
HD	11/100	5	9	0.0004	0.0029	16
HD	11/100	10	26	< 0.0001	0.0005	16
HD	11/100	21.1	> 60	< 0.0001	< 0.0001	16
HD (b)	7/100	21.1	45	< 0.0001	0.0001	21
GB	11/100	1	2	0.0118	0.1780	16
GB	11/100	2	3	0.0083	0.1071	16
GB	11/100	5	3	0.0033	0.0313	16
GB	11/100	10	6	0.0010	0.0071	16
GB	11/100	21.1	21	0.0001	0.0007	16
GB (b)	7/100	21.1	19	< 0.0001	0.0016	22
VX	7/100	1	> 60	< 0.0001	< 0.0001	14
VX	7/100	2	> 60	< 0.0001	< 0.0001	14
VX	7/100	5	> 60	< 0.0001	< 0.0001	14
VX	7/100	10	> 60	< 0.0001	< 0.0001	14
VX	7/100	21.1	> 60	< 0.0001	< 0.0001	14
VX (b)	5/100	21.1	> 60	< 0.0001	< 0.0001	16

(a) Carbon capcity = 0.05 lb agent/lb carbon. The filter inlet gas temperature calculated from heat balances. Worst-case fire size/combustion efficiency combination shown for the 1-second residence time.

(b) Same as in (a) except the worst-case fire size/combustion efficiency combination shown for the 21.1-second residence time.

residence time of 21.1 seconds is equivalent to a fire directly beneath the ECV exhaust duct. A worst-case residence time was assumed to be 1-second.

Table 13 gives a summary of agent releases during an ECV fire for variable carbon capacities. The carbon capacity has a significant effect on agent release. However, the amount of agent release was not directly proportional to the carbon capacity, but varied from about a two-fold to a ten-fold reduction in agent release as the carbon capacity was increased four-fold.

Table 14 gives a summary of agent releases during an ECV fire for various gas temperatures at the filter inlet. The lower gas temperature generally caused a reduction in the amount of HD and GB released by about two orders of magnitude.

The worst-case and most-credible-case agent releases for the ECV Area fire scenario are given in Table 15. The most credible case was based on a 21.1-second residence time for the volatilized agent in the ECV, a carbon capacity of 0.05 lb agent/lb carbon (worst case), a filter inlet gas temperature calculated from heat balances (worst case), and the worst-case fire size/combustion efficiency combination. The worst case was as above except for a 1-second residence time. The most credible case is still very conservative for reasons similar to those given in the TOX Area fire section.

3.1.4 Carbon Bed Fire. Two possible scenarios were considered for ignition of the carbon filter beds -- ignition from an entrained spark and spontaneous ignition. In the former scenario, a spark from a fire in the TOX, ECV, BSA or other area is entrained in the exhaust gases entering the filter banks. This would not cause a fire in the carbon bed because the pre-filter and HEPA filter, located upstream of the carbon beds, would stop the spark. These filters are composed of noncombustible fiberglass. The fiberglass would not achieve the melting temperature and allow the spark to pass through during any of the scenarios evaluated.

In the second scenario, the hot gases exhausted from a fire in the TOX, ECV, BSA, or other area or from a failure in the LIC ductwork, allowing exhaust gases from the operating LIC to enter the LIC room would heat the carbon bed. Based on the configuration of a CAMDS-type carbon bank, the

TABLE 13. SUMMARY OF ECV AREA FIRE CALCULATIONS (TON CONTAINER)[a]

Carbon Capacity Varied

Agent	Fire Size/ Combustion Efficiency (sq. ft./%)	Carbon Capacity (lb agent/ lb carbon)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	11/100	0.2	4	0.0016	0.0091	16
HD	11/100	0.05	4	0.0022	0.0208	16
HD [b]	7/100	0.2	> 60	< 0.0001	< 0.0001	21
HD [b]	7/100	0.05	45	< 0.0001	0.0001	21
GB	11/100	0.2	3	0.0072	0.0438	16
GB	11/100	0.05	2	0.0118	0.1780	16
GB [b]	7/100	0.2	42	< 0.0001	0.0004	22
GB [b]	7/100	0.05	19	< 0.0001	0.0016	22
VX	7/100	0.2	> 60	< 0.0001	< 0.0001	14
VX	7/100	0.05	> 60	< 0.0001	< 0.0001	14
VX [b]	5/100	0.2	> 60	< 0.0001	< 0.0001	16
VX [b]	5/100	0.05	> 60	< 0.0001	< 0.0001	16

(a) Gas temperature at filter inlet calculated from heat balances. The residence time of the fire products in the ECV area = 1 second. Worst-case fire size/combustion efficiency combinations shown.

(b) Same as in (a) except the residence time of the fire production in the ECV area = 21.1 seconds.

TABLE 14. SUMMARY OF ECV AREA FIRE CALCULATIONS (TON CONTAINER)[a]

Filter Inlet Gas Temperature Varied

Agent	Fire Size/ Combustion Efficiency (sq. ft./%)	Filter Inlet Gas Temperature (F)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	11/100	100	29	< 0.0001	0.0001	16
HD	11/100	115	4	0.0022	0.0208	16
HD [b]	7/100	100	59	< 0.0001	< 0.0001	21
HD [b]	7/100	103	45	< 0.0001	< 0.0001	21
GB	11/100	100	16	< 0.0001	0.0013	16
GB	11/100	117	2	0.0018	0.1780	16
GB [b]	7/100	100	32	< 0.0001	0.0002	22
GB [b]	7/100	105	19	< 0.0001	< 0.0001	22
VX	7/100	100	> 60	< 0.0001	< 0.0001	14
VX	7/100	120	> 60	< 0.0001	< 0.0001	14
VX [b]	5/100	100	> 60	< 0.0001	< 0.0001	16
VX [b]	5/100	117	> 60	< 0.0001	< 0.0001	16

(a) Carbon capcity = 0.05 lb agent/lb carbon. The residence time of the fire products in the ECV area = 1 second. Worst-case fire size/combustion efficiency combinations shown.

(b) Same as in (a) except the residence time of the fire products in the ECV area = 21.1 seconds.

TABLE 15. ECV AREA FIRE WORST CASE/MOST CREDIBLE CASE AGENT RELEASES

WORST CASE [a]

Agent	Fire Size (sq. ft.)	Combustion Efficiency (%)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	11	100	9	< 0.0001	0.0102	16
GB	11	100	7	0.0002	0.0090	16
VX	7	100	> 60	< 0.0001	< 0.0001	14

MOST CREDIBLE CASE [b]

Agent	Fire Size (sq. ft.)	Combustion Efficiency (%)	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After Maximum Fire Duration (lbs.)	Maximum Fire Duration with 99% Probability of Operator Closing Damper (Min.)
HD	11	100	11	< 0.0001	0.0035	16
GB	11	100	8	< 0.0001	0.0149	16
VX	7	100	> 60	< 0.0001	< 0.0001	16

(a) Carbon capacity = 0.05 lb agent/lb carbon, filter inlet gas temperature calculated from heat balances. The residence time of the fire products in the ECV area = 1 second.

(b) Carbon capacity = 0.2 lb agent/lb carbon, filter inlet gas temperature calculated from heat balances. The residence time of the fire products in the ECV area = one second.

minimum ignition temperature of the carbon was estimated to be 230 F (See Appendix A, pages A42 through A44). Raising the temperature of the carbon beds to 230 F or more could cause an ignition if sufficient time is allowed. To determine the sensitivity of temperature/time on carbon ignition, the worst-case filter inlet gas temperatures from the TOX, BSA and ECV Area fires were evaluated. The results, given in Table 16, indicate that spontaneous ignition is unlikely because of the short exposure periods of the carbon filter to elevated temperatures. No other scenarios for potential carbon ignition were identified.

3.1.5 Agent Feed to Nonoperating LIC. This scenario involves the following sequence of events:

(1) Shutdown of LIC burners/combustion air blowers while continued agent feed into the hot, but nonoperating LIC

(2) Closure of the LIC exhaust damper, thereby isolating the LIC from the PAS

(3) Vaporization of agent fed into the LIC as a result of contact with the hot refractory lining. There is a slight pressure buildup in the LIC until agent is vented into the LIC room, probably through the combustion air blower. The exhausted agent is then transported to the filter system via the ventilation.

The amount of agent released versus length of time that agent is fed into the nonoperating LIC was calculated. An agent flow rate into the LIC at a constant rate of 17.5 lb/min for HD and GB and 11.7 lb/min for VX was assumed as a worst case for the calculation. The previous fire scenarios indicated that the filter inlet gas temperature had a significant impact on the amount of agent released. As such, the temperature of the agent exhausted from the LIC was varied by changing the amount of refractory inside the LIC that is used to vaporize and heat the agent. These calculations are given in Appendix A, pages A45 through A49. Results of the calculations, given in Table 17, indicate that an operator has about 33 minutes to stop the agent feed into the nonoperating LIC before the agent release exceeds 0.001 lb.

TABLE 16. TIME REQUIRED FOR SPONTANEOUS IGNITION OF CARBON DUE TO HEATING

Scenario	Agent	Maximum T at Filters, °F	Time to Ignition of Activated Carbon	Fire Duration in Scenario, min.
TOX Fire[a]	HD	154	(b)	76 min
TOX Fire	GB	151	(b)	77 min
TOX Fire	VX	148	(b)	187 min
BSA Fire[a]	HD	305	80 min	8 min
BSA Fire	GB	296	85 min	6 min
BSA Fire	VX	287	100 min	17 min
ECV Fire[a]	HD	167	(b)	14 min
ECV Fire	GB	164	(b)	12 min
ECV Fire	VX	162	(b)	29 min
LIC[c]	All	230	>9 hrs	--

(a) All worst-case values given here

(b) Below minimum temperature required for ignition.

(c) LIC/AB exhausts into LIC area.

TABLE 17. AGENT RELEASE FROM CARBON FILTERS WHILE CONTINUED AGENT FEED INTO NON-OPERATING LIC

Agent	Fraction of LIC Refractory that Heats Agent	Time to Release >0.001 lb Agent (Min.)	Agent Released After 5 Minutes (lbs.)	Agent Released After 20 Minutes (lbs.)
HD	1.0[(a)]	33	< 0.0001	< 0.0001
HD	0.1	(b)	< 0.0001	< 0.0001
GB	1.0	33	< 0.0001	< 0.0001
GB	0.1	(b)	< 0.0001	< 0.0001
VX	1.0	> 60	< 0.0001	< 0.0001
VX	0.1	(b)	< 0.0001	< 0.0001

(a) 1.0 implies that the entire inner layer of high conductivity refractory (4-1/2-inch thick) within the volatilization chamber (52 inches ID by 7-ft. ht.) is available to volatilize agent fed into the LIC.

(b) The refractory cools to below the boiling point before <0.001 lb. is released.

3.1.6 Carbon Filter Desorption. A telephone conversation with Dr. Gerry Wood of the Air Purification Branch at the Chemical Research Development and Engineering Center revealed a general lack of agent desorption data. The desorption process cannot yet be modeled by empirical correlations. However, in qualitative terms, desorption may be insignificant. A report was cited (Reference 1) in which no GB or GD was desorbed after purging a carbon filter for 30 days at ambient temperature.

3.1.7 PAS Agent Scrubbing. The potential for agent removal in the PAS quencher was evaluated. The LIC PAS was used as the basis for the calculations. The calculations are given in Appendix A, pages A50 through A56.

The equations used to estimate agent scrubbing efficiency in the quencher indicated a strong dependence on the droplet size emitted from the quencher spray nozzle. Based on designed flow rates, the nozzles in the quencher should result in a median particle diameter of 1000 microns or less. A diameter of 4000 microns (worst case) and 100 microns (optimistic case) were also evaluated. The effect of gas residence time in the quencher was also evaluated ranging from 2.0 seconds (worst case) to 4.0 seconds (optimistic) as well as the 2.9 second designed residence time.

The results of the calculations are summarized in Table 18. The worst case agent removal efficiency (4000 micron particle size, 2.0 second residence time) was about 50 percent while the most optimistic (100 micron particle size, 4.0 second residence time) was over 99.999 percent. The most credible removal efficiency (1000 microns particle size, 2.9 second residence time) was 68.7 percent.

3.1.8 MPF/Full TC. The MPF accident that was evaluated involves inadvertent processing of a full TC in the MPF. It was assumed that the MPF burners would remain in operation after the TC was placed in the MPF (i.e., plant personnel were unaware that a full TC was placed in the MPF). Several scenarios were evaluated for this accident. Scenario 3 is considered to be the worst case.

In scenario 1, the agent volatilizes from the TC through punched holes at a rate dependent on the MPF burners heat duty. Sufficient area is

TABLE 18. AGENT REMOVAL IN LIC QUENCHER

Liquid Particle Size (Microns)	Residence Time of Gas in Quencher (Sec.)	Removal Efficiency (percent)
4000	2.0	49.7
4000	2.9[a]	63.1
4000	4.0	74.7
1000[b]	2.0	54.2
1000	2.9[a]	68.7
1000	4.0	80.5
100	2.0	98.7
100	2.9[a]	99.94
100	4.0	> 99.999

(a) Designed gas residence time.

(b) Typical median particle size from spray nozzle operating at flow rates specified on design drawings.

available in the punched holes so as to prevent over-pressurization of the TCs. Assumptions used in scenario 1 calculations include:

- A single TC placed in the MPF inadvertently
- Agent burns in the TC but container does not rupture
- Combustion-quench air at 3690 lb/hr in MPF
- Agent is at 120 F when placed in the MPF
- MPF operates at 1600 F
- Thermal input to TC is 1,745,953 Btu/hr (Radiation and Convection).

The calculations are given in Appendix A, pages A58 through A63. The agent flow rates from the MPF to the afterburner resulting from scenario 1 are shown in Table 19. The "agent not combusted", shown in Table 19, represents the amount of agent in lb/min not combusted in the MPF under stoichiometric conditions. These values are reasonable considering the fact that the MPF was designed to burn only residual agent on various metal parts and one TC. The agent not combusted in the MPF will flow into the afterburner via the MPF exhaust flow and will be thermally decomposed there if the afterburner continues to function, normally with a 2-second residence time for MPF exhaust. As such, no significant agent release to the environment would result during this scenario. Also, as described in the calculations (Appendix A), an agent vapor/air explosion should not be possible due to the limited amount of oxygen available in the MPF.

In scenario 2, the TC would rupture when heated in the MPF due to over-pressurization. The contents of the container would be ejected to the floor of the MPF. All of the agent is not vaporized instantly but, rather, the vaporization rate is dependent on the rate of heat transfer by conduction from the refractory to the agent. Assumptions used in scenario 2 calculations are as follows:

- The agent does not vaporize instantly and it is concentrated on the floor area
- Heat transfer to agent is primarily by conduction through the floor refractory

TABLE 19. TIMES TO VAPORIZE AGENT FROM ONE TON CONTAINER PLACED IN MPF

Agent	Time (min)	Mass Liq (lb)	Mass Vapor (lb)	Vapor Flow (cfm)	Mass of Agent Comb (lb/min)	Mass of Agent not Combusted (lb/min) to Afterburner
HD						
Boil (411 F)	6	1700	0	0	0	0
Sat Vap	15.8	0	1700	968	8.64	99.0
GB						
Boil (316 F)	4.2	1600	0	0	0	0
Sat Vap	12.3	0	1600	1353	7.0	124
VX						
Boil (568 F)	9.4	1500	0	0	0	0
Sat Vap	16.6	0	1500	486	4.0	86.4

- 4.5-in of refractory with high thermal conductivity contributes to heat flux into the liquid
- Agent spills at the boiling point
- Thermal conductivity of the 4.5-in refractory slab is 2.6 Btu/hr-ft-F
- Average slab temperature is 1600 F.

The calculations are given in Appendix A, pages A67 through A77. The agent flow rates from the MPF to the afterburner, summarized in Table 20, indicate that no significant agent release to the environment would occur during this scenario. These flows should be easily combusted in the afterburner since the residence time will be higher than normal without full MPF combustion exhaust. Since the flow capacity for the 24-in-diameter duct is approximately 2500 scfm at the nominal 2 iwg pressure differential between the MPF and afterburner, there will be no pressure rise in the MPF at these conditions.

In scenario 3, the TC ruptures and the entire contents are instantly vaporized. The agent flow rates from the MPF to the afterburner, the afterburner destruction efficiencies (the afterburner was assumed to flame out due to the large spike of agent vapor) and the amounts of agent released to the environment are given in Table 21. The calculations are given in Appendix A, pages A76 through A90. This scenario assumes, as a worst case, that the entire agent is vented through the afterburner. However, because of the over-pressure resulting from the vaporization of the agent, the MPF fume containment would be compromised, thereby expelling agent into the MPF area. Table 22 indicates that over-pressures that would likely cause MDB structural failure can occur if as little as one-fourth of the contents of a TC were expelled to the MPF room in this manner. Because two of the MPF walls are located adjacent to the outside, essentially all of the agent involved could be released to the environment. Any combination of variables could result in a significant agent release to the environment due to the large over-pressures. Although not quantitatively estimated, scenario 3 could result in the essentially instantaneous release of hundreds of pounds of agent to the environment.

TABLE 20. AGENT VAPORIZATION RESULTING FROM AGENT SPILLS ON HOT MPF FLOOR

Agent	Mass Agent Vapor Released (lbm)	Volume Agent Vapor (cu ft)	Time (min)	Ventilation Rate Required (cfm)
HD	1700	14070	16	879
	850	7517	8.2	916
	425	3896	4.1	950
VX	1500	7568	9.7	780
	750	3996	4.8	832
	375	2058	2.4	858
GB	1600	14952	14.2	1053
	800	8008	7.1	1128
	400	4156	3.5	1187

Table 21. Instantaneous Vaporization of Agent in MPF

Scenario No. 3. Analysis of Agent Breakthrough to AFB
Assumptions:
Instantaneous Agent Volitization in MPF
No Agent Pooling
Entire Refractory Volume Contributes to Vaporization (258 cu
Average Refractory Temperature 740 F

Parameters	HD	GB	VX
Ta (F)	707	708	717
Mass Agent (lbm) Worst Case	1700	1600	1500
MW (lb/mole)	159	140.1	267.4
R (ft-lbf/lbmole-R)	1545	1545	1545
Volume (cu ft)	768	768	768
Pressure Rise (psia)	174.3120	186.3500	92.23825
Density @Ta (lb/cu ft)	0.171656	0.149731	0.285643
Volume Req Vent (cfm)	9175.576	9809.240	4855.310
Vent Flow Inst Flash(cfm)	5044545.	5424744.	2452386.
CF Pressure	100.4037	107.3376	53.12923
Flow to MPH Exhaust (cfm)	84962.02	93113.15	47406.10
Actual Flow (acfm)	204168.4	223872.5	114514.1
Time to Purge Agent (sec)	2.696472	2.628970	2.543952
Mass of Agent to AFB (lbm)	1575.047	1468.750	1386.886

Calculation of AFB Breakthrough for AFB Flame Out

AFB Temp	Ta (F)	
Volume AFB in cu ft	522	

	HD	GB	VX
Residence Time (t) sec	0.153402	0.139901	0.273503
Mass Breakthrough in AFB (lbm)	611.2651	1079.514	1211.773
Destruction Efficiency (%)	0.611906	0.265011	0.126263

Calculation for AFB Breakthrough AFB Operating @ 1800 F

AFB Temp (F)	1800
Volume AFB in cu ft	522
MPF Exhaust @1600 F ACFM	12630
AFB Exhaust @1800 F ACFM	15670

	HD	GB	VX
Actual Flow to MPF (acfm)	205945.4	225649.5	116291.1
Mass of Agent To AFB (lbm)	1575.047	1468.750	1386.886
Residence Time (sec)	0.152079	0.138799	0.269323
Mass Breakthrough to AFB (lbm)	0	0	0
Destruction Efficiencey (%)	1	1	1

Table 22. MPF Area Overpressure Due to Expulsion of Agent Vapor from the MPF Furnace

Agent	Total Weight (lbs)	MPF Exit Temp. (F)	Agent Gas Volume (cu ft)	MPF Area Temp. (F)	Gas Volume @ ambient P (cu ft)	Vent Rate for No P rise (cfm)	MPF Area P Rise (psig)
HD	1700	1331	13969	639	72754	4,810,075	18.04
HD	850	1454	7464	460	57283	2,953,613	11.07
HD	425	1524	3869	286	45038	1,484,152	5.57
GB	1600	1362	15187	675	75702	5,163,885	19.36
GB	800	1470	8044	484	59055	3,166,191	11.87
GB	400	1532	4151	302	46094	1,610,899	6.04
VX	1500	1335	7349	645	69069	4,367,917	16.38
VX	750	1455	3920	464	55844	2,780,890	10.43
VX	375	1525	2032	290	44536	1,423,940	5.34

3.2 Summary/Conclusions

Sensitivity analyses were performed for several accident scenarios involving relatively large quantities (i.e. over 100 pounds) of agent. A summary of agent releases for the accident scenarios evaluated are given in Table 23. Other conclusions are as follows:

- Insufficient information is available to quantify desorption of agent from carbon filters.
- Between 50 (worst-case) and 99.999 (most-credible-case) percent removal efficiencies of agent are anticipated in the PAS quencher.

3.3 References

1) Morrison, R. W.; Rogers, C. L.; Grue, R. C.; and Hiob, G. D.; "Effect of Relative Humidity on the Performance of ASC Carbon in the Removal of Chemical Agents", CRDC-TR-86012, February, 1986.

TABLE 23. SUMMARY OF AGENT RELEASES FROM ACCIDENT SCENARIOS EVALUATED IN THE SENSITIVITY ANALYSES

Scenario	Agent	Worst-Case Agent Release (lbs)	Most-Credible-Case Agent Release (lbs)
TOX Area Fire	HD	0.2814	0.0050
	GB	6.4324	0.1613
	VX	< 0.0001	< 0.0001
BSA Area Fire(b)	HD	75.2408	6.8254
	GB	168.7586	28.8833
	VX	0.1391	< 0.0001
BSA Area Fire(c)	HD	0.0004	–
	GB	0.3593	–
	VX	< 0.0001	–
ECV Area Fire	HD	0.0288	0.0001
	GB	0.1788	0.0016
	VX	< 0.0001	< 0.0001
Carbon Filter Fire	HD	(d)	(d)
	GB	(d)	(d)
	VX	(d)	(d)
Agent Feed to non-operating LIC	HD	< 0.0001	< 0.0001
	GB	< 0.0001	< 0.0001
	VX	< 0.0001	< 0.0001
Feed Full TC into MPF (Scenarios 1 and 2)	HD	< 0.0001	–
	GB	< 0.0001	–
	VX	< 0.0001	–
Feed Full TC into MPF (Scenario 3)	HD	> 100	–
	GB	> 100	–
	VX	> 100	–

(a) Agent releases for the fire scenarios are for the maximum fire duration.
(b) The agent releases given here are for a leaking TC.
(c) The agent releases given here are for a ruptured TC and assumes agent release from a sump fire.
(d) Ignition of the carbon is not anticipated in any of the evaluated scenarios.

APPENDIX C
STRUCTURAL ANALYSIS

C.1. STRUCTURAL ANALYSIS

This appendix summarizes the structural analysis methodology used to determine failure thresholds and probabilities for munitions and structures. Supporting calculation for the results used in this study can be found in Ref. C-1.

C.1.1. PUNCTURE

This section addresses two types of munition puncture: (1) puncture due to dropping a munition; and (2) forklift puncture.

C.1.1.2. Puncture Due to Drop

The probability P_F of a munition puncturing on impact with a probe depends on the type of munition, the number of probes to which a dropped munition is exposed, and the geometry of the probe. This probability is computed from the following:

$$P_F = P_B \times PLL \times PD \times A_S \quad ,$$

where P_B = probe density (number of probes per square foot of surface area),

PLL = an admissible probability value for probe length to diameter ratio,

PD = an admissible probability value for probe diameter,

A_s = the area of the munition in square feet which is subject to penetration by the probe.

The number of probes per square foot of surface area (P_B) is based on engineering judgment. It is assumed that the igloo is clean and that objects that could be potential probes are not likely to be left in the igloo. Therefore, one probe per igloo (i.e., one probe per 2160 ft^2) was assumed for igloo storage. For all other storage areas, a probe density of one per 1000 ft^2 was assumed. In the general working area, loading docks, etc., it is assumed that the potential for probes will be much more likely than in an igloo. Probes such as posts, tools, rocks, or chunks of steel are possible; therefore, one probe per 100 ft^2 is assumed for the general working area. In the UPA during an earthquake, it is assumed that the earthquake could generate additional probes by causing objects to fall onto the floor; therefore, one probe per 50 ft^2 is assumed for the UPA during an earthquake.

The PLL term in the above expression represents the probability that the probe has a length-to-diameter ratio (L/D) which is less than that which would cause buckling failure of the probe without penetration of the dropped munition but greater than that corresponding to a probe length which is insufficient to penetrate the munition. Probe dimensions (diameter and L/D) were treated statistically and the minimum probe length for penetration was calculated for each munition.

The PD term in the above expression represents the probability that the diameter of the probe is less than or equal to the maximum that could penetrate the munition but greater than a minimum diameter corresponding to the compressive strength of the probe. The maximum diameter of the probes which could penetrate through the munition wall is determined from

$$D_u = \frac{(W \times H)^{0.667}}{672\ t} \quad ,$$

where D_u = maximum probe diameter (in.),

W = weight of munition/pallet (lb),

H = drop height (ft),

t = munition thickness (in.).

These expressions are taken from Ref. C-2.

The munition area vulnerable to probe penetration (A_s) was determined assuming a maximum probe length of 2 in. This term was calculated for each munition/pallet configuration of interest and reflects the number of munitions involved in each handling operation. Thus, if more than one munition were being handled, the vulnerable area of each munition was multiplied by the actual number of munitions involved in the handling event.

C.1.1.2. Forklift Tine Puncture

For forklift tine puncture, the munitions are at rest and the probe (the forklift tine) is the moving object. This makes calculating the munition vulnerability simpler since the mass of the moving object (the forklift) and the shape of the probe (the tine) are the same for all munitions. The only variable is the munition thickness. Since the puncture energy is proportional to the thickness of the munition, the relative puncture resistance of the munitions is simply the ratio of the thicknesses.

The probability P of a forklift tine puncture of the munitions was assumed to be governed by

$$P = P_1 * P_2 * N \quad ,$$

where P_1 = the probability that a munition is struck by a forklift tine per pallet operation,

P_2 = the probability that the munition is punctured given that the forklift tine strikes the munition,

N = number of handling operations.

The critical puncture velocity V_c (in ft/s) was determined from

$$V_c = \frac{64}{W} (672\ Dt)^{3/2} \quad ,$$

where W = weight of the forklift (lb),

D = equivalent diameter of the forklift tine (in.),

t = munition wall thickness (in.).

C.1.2. WIND-GENERATED MISSILES

The probability of a wind-generated missile rupturing a munition is the product of two probabilities: (1) the probability of having a wind of sufficient velocity to generate a missile that can rupture a munition and (2) the probability that the missile hits the munitions in an orientation that will rupture the munition.

C.1.2.1. Required Wind Velocity

The wind velocity required to generate a missile that can penetrate a munition is computed as follows:

1. The missile velocity required to penetrate the munition is computed using the equation (Ref. C-2):

$$V_m = 0.682 \quad \frac{64}{W} (672\ Dt)^{3/2} \quad ,$$

where V_m = the penetration velocity (mph),
W = the weight of the missile (lb),
D = the equivalent missile diameter (in.),
t = the wall thickness of the munition (in.).

Each munition was evaluated for two critical missiles: a 10-ft section of 3-in. pipe and a 13.5-in. diameter utility pole. In addition to penetration, the utility pole was evaluated to determine the velocity required to crush the munition.

2. The missile velocity required to penetrate the storage structure was also computed using the following equation (Ref. C-2).

For concrete structures:

$$V_s = 1000 \; {\frac{f_c \; T \; D^{1.8}}{427 \; W}}^{0.75} \quad ,$$

where T = thickness of concrete element to be just perforated (in.),

W = weight of missile (lb),

D = diameter of missile (in.),

V_s = striking velocity of missile (fps),

f_c = compressive strength of concrete (psi).

For steel structures:

$$V_s = 0.682 \; \frac{64}{W} \; (672 \; DT)^{3/2} \quad .$$

3. The missile velocity required to penetrate both the munition and structure is computed using the following equation which is based on summing the energies required to penetrate the munition and structure separately:

$$V = \sqrt{V_m^2 + V_s^2} \quad ,$$

where V_m = velocity required to penetrate the munition,

V_s = velocity required to penetrate the structure.

4. The probability of the required wind occurring was based on functional data for each site.

C.1.2.2. Probability of Hitting and Rupturing the Munition

Given a sufficient wind, the probability that a missile hits and ruptures a munition was computed from:

$$P = P_d \, P_o \, D \, A \quad ,$$

where P_d = probability that the direction of missile travel is nearly perpendicular to the target,

P_o = probability that the missile is oriented to penetrate (i.e., not tumbling or going sideways),

D = number of missiles per unit area,

A = area of target.

Values for P_d, P_o, and D are difficult to evaluate and are not available from the literature. Consequently, the values used for the analysis were computed based on engineering judgment. These values were selected to give a "best estimate" of the overall probability. The following is a discussion of these assumptions.

The missile velocity must be nearly perpendicular to the wall of a structure or munition in order for the missile to penetrate. The further the missile strikes from an angle which is perpendicular, the less likely that the missile will penetrate. As the angle deviates from the perpendicular, the effective thickness of munition increases proportionally to the reciprocal of the cosine of the angle (where the angle is measured from the perpendicular); thus, a higher missile velocity (which has a lower probability of occurring) is required for penetration. In addition, the missile is more likely to ricochet at higher angles. Based on engineering judgment, it is estimated that if the

missile velocity is more than 30 deg off from perpendicular, the missile will not penetrate. This yields a value of 0.17 for P_d.

The missile velocity must be aligned along the missile axis in order for the missile to penetrate. In other words, the missile must move like an arrow rather than tumbling or going sideways. Of the two missiles analyzed, it was found that it is more important that the pipe be aligned properly than the utility pole because of the larger impact area of the utility pole. For this reason, it was assumed that the velocity must be aligned within 5 deg of the axis of the pipe and within 10 deg of the axis of the utility pole. These assumptions resulted in values for P_o of 0.004 for the pipe and 0.015 for the utility pole.

The path of the tornado is generally from 1/8 to 3/4 of a mile wide (Ref. C-3). For this analysis, it was assumed that the tornado is 1/2 mile wide and that it carries one utility pole and 10 iron pipes. It was further assumed that the pipes are evenly distributed to a height of 50 ft and the utility pole at a height of 20 ft (Ref. C-4 indicates the maximum heights for pipes is 100 ft and for utility poles is 50 ft which indicates that our assumption is conservative). Therefore, the number of missiles per square foot of wind (D) is 7.6×10^{-5} for pipes and 1.9×10^{-5} for utility poles.

The target area is different for each scenario and depends on the number of munitions involved and the storage configuration (see Ref. C-1).

The product of P_d, P_o, and D is approximately 5.0×10^{-8} for both the pipes and utility pole.

C.1.3. EARTHQUAKE AND WIND FAILURE OF UBC DESIGNED STRUCTURES

C.1.3.1. Strength Factor of Safety

The Uniform Building Code (UBC) ensures that structures are designed with a factor of safety. This factor of safety varies depending on the type of structure, materials used and components selected. For earthquake and wind loads, this factor of safety ranges from 1.3 to 1.6 for concrete structures designed to ultimate design strength principals and from 2.6 to 3.0 for concrete and steel structures designed to working stress methods. For the risk analyses in this report, it is assumed that the factor of safety will be 1.3 for concrete structures (since the CONUS structures are being designed to ultimate strength) and 2.6 for the steel structures.

C.1.3.2. Wind Loads

For UBC-designed concrete structures such as the MDB, wind does not govern the design of the main structural components. The MDB is a rigid concrete moment resisting framed and shear wall structure and will fail under seismic conditions only. For the steel structures such as the bulk agent warehouses, the wind governs the design in most cases. Wind loads will fail the walls of the structure before the structure will collapse. Since the stresses in a structure due to winds are proportional to the square of the wind velocity, a wind velocity which is 1.6 (square root of the 2.6 factor of safety on strength) times greater than the design wind load can be expected to fail the walls of the steel structure.

C.1.3.3. Earthquake Loads

The Applied Technology Council (ATC), which is associated with the SEAOC, presents a set of curves that can be used to estimate the probability of an earthquake, which exceeds a specific g-level, occurring

anywhere in the U.S. (Ref. C-5). These curves are shown in Section 4.2. Each curve represents a seismic map area which is similar to the seismic zones used by the UBC. The ATC divided the country into seven seismic map areas (1-7). The UBC uses five seismic zones (0-4). Reference C-5 contains maps showing the seismic map areas. These maps color code the seismic map areas, and, consequently, have not been reproduced for this report since a black and white reproduction would not be helpful. The maps show that APG, ANAD, LBAD, PBA, UMDA, and PUDA are in seismic map area 2; NAAP is in seismic map area 3; and TEAD is in seismic map area 5.

Section 4.2 presents the seismic risk curves for seismic map areas 2, 3, 5, and 7.

The earthquake g-level that will fail a structure depends on four principal factors: (1) the design g-level, (2) the strength factor of safety, (3) the dynamic amplification in the structure, and (4) the ductility of the structure. The dynamic amplification factor reduces the factor of safety, and the ductility increases the factor of safety. The dynamic amplification factor has been conservatively estimated at 2.3 based on a referenced analysis (Ref. C-6). Ductility factors are estimated to be in the range of 2.5 to 3.5 for concrete structures with shear walls and from 3.5 to 5.0 for steel structures. For this analysis, 2.5 was used for concrete walls and 3.5 was used for steel-walled structures. Based on these factors, a UBC structure with concrete walls was assumed to fail at an earthquake g-level that is approximately 1.4 times the design g-level, and a UBC structure with steel walls was assumed to fail at a g-level that is approximately 4.0 times greater than the design g-level.

For UBC designed structures with concrete walls in Seismic Zone 3 (design g-level of 0.14), the expected failure g-level is 0.4 g. Due to the uncertainty of the analysis, there is a probability that the structure will survive larger earthquakes or will fail during smaller

earthquakes. Consequently, the following probabilities of failure have been assumed:

1. A 0.3-g earthquake has a 0.1 probability of producing failure.
2. A 0.4-g earthquake has a 0.5 probability of producing failure.
3. A 0.5-g earthquake has a 0.9 probability of producing failure.
4. A 0.6-g earthquake has a 1.0 probability of producing failure.

The failure g-levels for Seismic Zone 2 are half of the g-levels for Seismic Zone 3 since the design g-level for Seismic Zone 2 (0.07 g) is half the design g-level for Seismic Zone 3 (0.14 g).

For UBC designed structures with steel walls in Seismic Zone 2 (the warehouses at NAAP and UMDA), the following probabilities of failure have been assumed:

1. A 0.2-g earthquake has a 0.1 probability of producing failure.
2. A 0.3-g earthquake has a 0.5 probability of producing failure.
3. A 0.4-g earthquake has a 0.9 probability of producing failure.
4. A 0.5-g earthquake has a 1.0 probability of producing failure.

C.1.4. EARTHQUAKE FAILURE OF NRC-DESIGNED STRUCTURES

The TOX cubicle, tank, and piping system will be designed to Nuclear Regulatory Commission (NRC) standards for nuclear power plants. In summary, this will involve the following:

1. Seismic experts will determine the "maximum credible earthquake" that can occur at TEAD based on the seismic history of the area and the proximity of earthquake faults. This "maximum credible earthquake" will be selected as the safe shutdown earthquake (SSE) to be used as the design earthquake for the TOX at all eight sites.

2. The TOX will be analyzed for the SSE using finite-element time-history computer programs.

3. The TOX will be constructed to NRC standards.

Since the design g-level has not yet been determined, an SSE g-level had to be assumed with the intent to ensure that the TOX will withstand relatively high g-forces. For this risk analysis, it was conservatively assumed that the TOX will be designed for a 1-g SSE.

Since the TOX will be designed for no failures in the event of a SSE, an earthquake larger than the SSE will be required to produce a failure. Since the NRC seismic design requirements are quite different from the UBC seismic requirements, the methodology used to determine failure g-levels for the UBC structures does not apply to NRC-designed structures. Based on GA's experience in seismic design of nuclear power plants, it was estimated that an earthquake which is twice the SSE will have a 0.5 probability of either rupturing the TOX tank/piping system or breaching the TOX wall. There is a possibility that the TOX will survive larger earthquakes or that a smaller earthquake will cause a

failure. Consequently, the following probabilities are selected for the rupture of the TOX storage tank and for the breaching of the TOX walls:

1. A 1.8-g earthquake has a 0.1 probability of producing failure.
2. A 2.0-g earthquake has a 0.5 probability of producing failure.
3. A 3.0-g earthquake has a 0.9 probability of producing failure.
4. A 4.0-g earthquake has an ~1.0 probability of producing failure.

C.1.5. METEORITES

The probability of a meteorite penetrating a munition can be estimated from:

$$P = F\ (f_i + f_s)\ A\ S \quad ,$$

where F = frequency of meteorite strikes per square foot of area,

f_i = fraction of the striking meteorites which are iron meteorites and can penetrate the target,

f_s = fraction of the striking meteorites which are stone meteorites and can penetrate the target,

A = area of target,

S = fraction of the target area which must be impacted to rupture a munition or bulk agent container (spacing factor).

The frequency of meteorite strikes for meteorites 1.0 lb or greater is $0.4 \times 10^{-13}/ft^2$ (Ref. C-7). For small meteorites (a ton or less), stone meteorites are approximately 10 times more common than iron meteorites (Ref. C-8). However, iron meteorites are more dense and tend to have higher impact velocities, and consequently, represent a significant portion of the total meteorites that can rupture munitions. The size distribution of both iron and stone meteorites striking the earth surface was estimated from the data presented in Refs. C-7 and C-8.

The size of the meteorite required to penetrate a munition or munition and structure was computed using the equations presented in Ref. C-2. The impact velocity was computed based on the data presented

in Ref. C-8, which gives impact velocities for a series of large meteorites. These data were plotted and extrapolated to estimate the velocities for the smaller meteorites. For the smallest stone meteorites, the extrapolation yields impact velocities which were less than their terminal velocities. In these cases the terminal velocities are used.

C.1.6. AIRCRAFT CRASH

The probabilities used in the analysis of crashes involving aircraft takeoffs and landings were obtained by modifying Table C-1, which was taken from Ref. C-9. The following modifications were made to this table:

1. U.S. air carrier (commercial) crash probabilities between 5 and 8 miles from the end of the runway were increased from 0.0 to 0.14×10^{-8} which is equal to the probability for crashes between 8 and 9 miles from the end of the runway.

2. The probabilities for USN/USMC were averaged with the probabilities for USAF to obtain probabilities for military aircraft in general.

3. The probabilities for crashes of military aircraft at distances which are 5 to 10 miles from the runway were assumed to be the same as for U.S. commercial air carriers.

4. The general aviation probabilities for crashes which are 5 to 10 miles from the end of the runway are assumed to be five times greater than U.S. air carrier probabilities.

5. Helicopter crash probabilities were assumed to be twice the probabilities for general aviation.

Tables C-2 through C-17 summarize the input data that were used to calculate the annual probabilities of both small and large aircraft crashes at each of the eight sites. The effective areas of the crash sites are summarized in Table C-18.

TABLE C-1
AIRCRAFT CRASH PROBABILITIES NEAR AIRPORTS[a]

Distance From End of Runway (miles)	Probability (x 10^8 of a Fatal Crash per Square Mile per Aircarft Movement[a]			
	U.S. Air Carrier	General Aviation	USN/USMC	USAF
0-1	16.7	84.0	8.3	5.7
1-2	4.0	15.0	1.1	2.3
2-3	0.96	6.2	0.33	1.1
3-4	0.68	3.8	0.31	0.42
4-5	0.27	1.2	0.20	0.40
5-6	0	NA	NA	NA
6-7	0	NA	NA	NA
7-8	0	NA	NA	NA
9-9	0.14	NA	NA	NA
9-10	0.12	NA	NA	NA

[a]Reference C-9.

TABLE C-2
CRASH OF A LARGE AIRPLANE AT APG

AIRWAYS

		COMMERCIAL			MILITARY			GENERAL AVIATION			ALL
ROUTE	ROUTE WIDTH	N	C1	P	N	C1	P	N	C1	P	P
NONE											0

AIRPORTS

		COMMERCIAL			MILITARY			GENERAL AVIATION			ALL
AIRPORT	MILES TO SITE	N	C2	P	N	C2	P	N	C2	P	P
PHILLIPS AAF	8	1.2e+01	1.4e-09	1.7e-08	1.0e+02	1.4e-09	1.5e-07	5.2e+01	7.0e-09	3.6e-07	5.3e-07
WEIDE AAF	1	0.0e+00	1.7e-07	0.0e+00	0.0e+00	7.0e-08	0.0e+00	0.0e+00	8.4e-07	0.0e+00	0.0e+00
										TOTAL	5.3e-07

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-3
CRASH OF A SMALL AIRPLANE AT APG

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
-	5	1.2e+01	4.0e-10	9.6e-10	2.4e+01	2.0e-09	9.6e-09	1.2e+01	2.0e-09	4.8e-09	1.5e-08

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
PHILLIPS AAF	8	1.2e+01	1.4e-09	1.7e-08	2.4e+01	1.4e-09	3.4e-08	2.4e+01	7.0e-09	1.7e-07	2.2e-07
WEIDE AAF	1	0.0e+00	1.7e-07	0.0e+00	4.0e+02	7.0e-08	2.8e-05	1.3e+03	8.4e-07	1.1e-03	1.1e-03
										TOTAL	1.1e-03

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-4
CRASH OF A LARGE AIRPLANE AT ANAD

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
J14-52	8	1.0e+04	4.0e-10	5.0e-07	5.0e+03	2.0e-09	1.3e-06	5.0e+03	2.0e-09	1.3e-06	3.0e-06
V18	12	4.0e+03	4.0e-10	1.3e-07	2.4e+03	2.0e-09	4.0e-07	4.0e+03	2.0e-09	6.7e-07	1.2e-06
IR69	4	0.0e+00	4.0e-10	0.0e+00	7.3e+03	2.0e-09	3.7e-06	0.0e+00	2.0e-09	0.0e+00	3.7e-06

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
NONE											0.0e+00
										TOTAL	7.9e-06

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-5
CRASH OF A SMALL AIRPLANE AT ANAD

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
J14-52	8	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00
V18	12	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	7.0e+04	2.0e-09	1.2e-05	1.2e-05
IR69	4	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
NONE											0.0e+00
										TOTAL	1.2e-05

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-6
CRASH OF A LARGE AIRPLANE AT LBAD

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
J6	8	5.0e+03	4.0e-10	2.5e-07	2.5e+03	2.0e-09	6.3e-07	2.5e+03	2.0e-09	6.3e-07	1.5e-06
J43	12	5.0e+03	4.0e-10	1.7e-07	2.5e+03	2.0e-09	4.2e-07	2.5e+03	2.0e-09	4.2e-07	1.0e-06
BOMBING RUN	4	0.0e+00	4.0e-10	0.0e+00	4.0e+03	2.0e-09	2.0e-06	0.0e+00	2.0e-09	0.0e+00	2.0e-06

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
NONE											0.0e+00
										TOTAL	4.5e-06

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-7
CRASH OF A SMALL AIRPLANE AT LBAD

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
J6	8	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00
J43	12	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00
BOMBING RUN	4	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00
-	8	4.0e+02	4.0e-10	2.0e-08	2.4e+02	2.0e-09	6.0e-08	4.0e+02	2.0e-09	1.0e-07	1.8e-07

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
NONE											0.0e+00
										TOTAL	1.8e-07

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-8

CRASH OF A LARGE AIRPLANE AT NAAP

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
J73	8	5.0e+03	4.0e-10	2.5e-07	2.5e+03	2.0e-09	6.3e-07	2.5e+03	2.0e-09	6.3e-07	1.5e-06
J80	8	5.0e+03	4.0e-10	2.5e-07	2.5e+03	2.0e-09	6.3e-07	2.5e+03	2.0e-09	6.3e-07	1.5e-06
V171	8	2.0e+03	4.0e-10	1.0e-07	1.2e+03	2.0e-09	3.0e-07	2.0e+03	2.0e-09	5.0e-07	9.0e-07
V434	10	2.0e+03	4.0e-10	8.0e-08	1.2e+03	2.0e-09	2.4e-07	2.0e+03	2.0e-09	4.0e-07	7.2e-07

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
ROWE	8	0.0e+00	1.4e-09	0.0e+00	0.0e+00	1.4e-09	0.0e+00	0.0e+00	7.0e-09	0.0e+00	0.0e+00
										TOTAL	4.6e-06

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-9
CRASH OF A SMALL AIRPLANE AT NAAP

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
J73	8	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00
J80	8	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00
V171	8	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	3.5e+04	2.0e-09	8.7e-06	8.7e-06
V434	10	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	3.5e+04	2.0e-09	7.0e-06	7.0e-06

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
ROWE	8	0.0e+00	1.4e-09	0.0e+00	0.0e+00	1.4e-09	0.0e+00	1.0e+03	7.0e-09	7.0e-06	7.0e-06
										TOTAL	2.3e-05

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-10
CRASH OF A LARGE AIRPLANE AT PBA

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
J42	8	5.0e+03	4.0e-10	2.5e-07	2.5e+03	2.0e-09	6.3e-07	2.5e+03	2.0e-09	6.3e-07	1.5e-06

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
NONE											0.0e+00
										TOTAL	1.5e-06

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-11
CRASH OF A SMALL AIRPLANE AT PBA

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
J42	8	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00
-	8	4.0e+02	4.0e-10	2.0e-08	2.4e+02	2.0e-09	6.0e-08	4.0e+02	2.0e-09	1.0e-07	1.8e-07

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
NONE											0.0e+00
										TOTAL	1.8e-07

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-12
CRASH OF A LARGE AIRPLANE AT PUDA

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
J28	8	1.0e+03	4.0e-10	5.0e-08	5.0e+02	2.0e-09	1.3e-07	5.0e+02	2.0e-09	1.3e-07	3.0e-07
J17	10	1.0e+03	4.0e-10	4.0e-08	5.0e+02	2.0e-09	1.0e-07	5.0e+02	2.0e-09	1.0e-07	2.4e-07
V10-244	8	4.0e+02	4.0e-10	2.0e-08	2.4e+02	2.0e-09	6.0e-08	4.0e+02	2.0e-09	1.0e-07	1.8e-07
V19-83	8	4.0e+02	4.0e-10	2.0e-08	2.4e+02	2.0e-09	6.0e-08	4.0e+02	2.0e-09	1.0e-07	1.8e-07
V81	10	4.0e+02	4.0e-10	1.6e-08	2.4e+02	2.0e-09	4.8e-08	4.0e+02	2.0e-09	8.0e-08	1.4e-07
V389	10	4.0e+02	4.0e-10	1.6e-08	2.4e+02	2.0e-09	4.8e-08	4.0e+02	2.0e-09	8.0e-08	1.4e-07

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
PUEBLO MEMORIAL	8	9.1e+03	1.4e-09	1.3e-05	9.1e+03	1.4e-09	1.3e-05	4.6e+03	7.0e-09	3.2e-05	5.8e-05
										TOTAL	5.9e-05

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-13
CRASH OF A SMALL AIRPLANE AT PUDA

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
J20	8	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00
J17	10	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00
V10-244	8	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	7.0e+03	2.0e-09	1.7e-06	1.7e-06
V19-83	8	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	7.0e+03	2.0e-09	1.7e-06	1.7e-06
V81	10	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	7.0e+03	2.0e-09	1.4e-06	1.4e-06
V389	10	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	7.0e+03	2.0e-09	1.4e-06	1.4e-06

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
PUEBLO MEMORIAL	8	0.0e+00	1.4e-09	0.0e+00	0.0e+00	1.4e-09	0.0e+00	1.4e+04	7.0e-09	9.8e-05	9.8e-05
										TOTAL	1.0e-04

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-14
CRASH OF A LARGE AIRPLANE AT TEAD

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
V257	8	8.0e+02	4.0e-10	4.0e-08	4.8e+02	2.0e-09	1.2e-07	8.0e+02	2.0e-09	2.0e-07	3.6e-07

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
NONE											0.0e+00
										TOTAL	3.6e-07

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-15
CRASH OF A SMALL AIRPLANE AT TEAD

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
V257	8	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	1.4e+04	2.0e-09	3.5e-06	3.5e-06

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
NONE											0.0e+00
										TOTAL	3.5e-06

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-16
CRASH OF A LARGE AIRPLANE AT UMDA

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
J54	8	1.0e+04	4.0e-10	5.0e-07	5.0e+03	2.0e-09	1.3e-06	5.0e+03	2.0e-09	1.3e-06	3.0e-06
J20	12	1.0e+04	4.0e-10	3.3e-07	5.0e+03	2.0e-09	8.3e-07	5.0e+03	2.0e-09	8.3e-07	2.0e-06
V4	12	4.0e+03	4.0e-10	1.3e-07	2.4e+03	2.0e-09	4.0e-07	4.0e+03	2.0e-09	6.7e-07	1.2e-06
VR1354	6	0.0e+00	4.0e-10	0.0e+00	2.5e+04	2.0e-09	8.3e-06	0.0e+00	2.0e-09	0.0e+00	8.3e-06

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
NONE											0.0e+00
										TOTAL	1.5e-05

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-17
CRASH OF A SMALL AIRPLANE AT UMDA

AIRWAYS

ROUTE	ROUTE WIDTH	COMMERCIAL N	COMMERCIAL C1	COMMERCIAL P	MILITARY N	MILITARY C1	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C1	GENERAL AVIATION P	ALL P
J54	8	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00
J20	12	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00
V4	12	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	7.0e+04	2.0e-09	1.2e-05	1.2e-05
VR1354	8	0.0e+00	4.0e-10	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00	2.0e-09	0.0e+00	0.0e+00

AIRPORTS

AIRPORT	MILES TO SITE	COMMERCIAL N	COMMERCIAL C2	COMMERCIAL P	MILITARY N	MILITARY C2	MILITARY P	GENERAL AVIATION N	GENERAL AVIATION C2	GENERAL AVIATION P	ALL P
NONE											0.0e+00
										TOTAL	1.2e-05

N = Number of flights per year
C1= Probability of a crash per mile
C2= Probability of a crash per sq. mile
P = Probability of a crash per sq. mile per year

TABLE C-18
EFFECTIVE AREAS OF CRASH SITES[a]

Storage Facility	Large Aircraft Direct Crash	Large Aircraft Adjacent Crash	Small Aircraft Direct Crash
80-ft igloo	7.6E-5	4.8E-5	0.0E+0
60-ft igloo	5.7E-5	3.7E-5	0.0E+0
40-ft igloo	3.8DE-5	2.4E-5	0.0E+0
89-ft magazine	8.2E-5	4.6E-5	0.0E+0
Warehouse at TEAD	2.4E-3	2.4E-3	3.0E-3
Warehouse at UMDA	1.6E-3	1.8E-3	2.1E-3
Warehouse at NAAP	7.9E-4	1.7E-3	1.3E-3
Open storage at APG	4.6E-3	4.9E-3	5.7E-3
Open storage at PBA	1.1E-2	6.6E-3	1.3E-2
Open storage at TEAD	2.2E-2	1.2E-2	2.5E-2
Train (50 cars)	1.1E-2	1.6E-2	5.4E-3
ECR	5.4E-5	--	--
UPA	2.4E-4	--	1.6E-4
TOX	4.1E-5	--	--
Truck	3.6E-4	--	9.0E-5
Outside agent piping at TEAD	1.8E-3	--	5.9E-4

[a]Units of area is square miles.

C.1.7. REFERENCES

C-1. "Supporting Calculations for the Risk Analysis of the Disposal of Chemical Munitions at National or Regional Sites," GA Report EPS-GA/DP-0092, August 1987.

C-2. "Design of Structures for Missile Impact," Bechtel Power Corporation, BC-TO-9A, September 1974.

C-3. "Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites," ANSI/ANS-2.3-1983, 1983.

C-4. Coats, D. W., "National Phenomena Hazards Modeling Project: Extreme Wind/Tornado Hazard Models for Department of Energy Sites," UCRL-53526, Lawrence Livermore National Laboratory, February 1984.

C-5. "Tentative Provisions for the Development of the Seismic Regulations for Buildings," Applied Technology Council, ATC 3-06, NBS SP-510, NSF 78-8, June 1978.

C-6. "Structural Analysis and Design of Nuclear Plant Facilities," American Society of Civil Engineers, Manuals and Reports on Engineering Practice No. 58, 1980.

C-7. Solomon, K. A., K. C. Erdmann, and D. Okrent, "Estimate of the Hazards to a Nuclear Reactor from the Random Impact of Meteorites," Nuclear Technology, Vol. 25, January 1975.

C-8. Blake, V. E., "A Prediction of the Hazards from the Random Impact of Meteorites on the Earth's Surface," Sandia Laboratories SC-RR-86-838, December 1968.

C-9. "USNRC Standard Review Plan," Section 3.5.1.6, "Aircraft Hazards," U.S. Nuclear Regulatory Commission, NUREG-0800, July 1981.

APPENDIX D
SITE INFORMATION

D.1. SITE INFORMATION

This appendix discusses the location and characteristics of the eight CONUS sites where chemical munitions are stored and provides a brief description of the storage areas. Figure D-1 shows the general location of the eight sites. The site characteristics discussed included recorded earthquake activity and aircraft patterns in the vicinity.

D.1.1. ABERDEEN PROVING GROUND

As shown in Figs. D-2 and D-3, the Aberdeen Proving Ground (APG) is located in Harford County, Maryland near the head of the Chesapeake Bay.

APG is a Test and Evaluation Command (TECOM) installation within U.S. Army Materiel Command (AMC). The main activities/mission of APG include testing and evaluating vehicles, munitions, and other combat hardware. A major tenant activity, the Chemical Research, Development, and Engineering Center (CRDEC), is located at APG.

APG is comprised of two general areas, the Aberdeen Area and Edgewood Area. The Edgewood Area is situated adjacent to the town of Edgewood in the southwestern part of Harford County. There have occurred in the vicinity of the APG site 48 recorded earthquakes of Modified Mercalli Intensity (MMI) levels from I to VII, as summarized in Table D-1.

The chemical storage area at APG is located in the northeast corner of the Edgewood Area. The Chemical Agent Storage Yard (CASY) is an open area encompassing approximately 5 acres and is situated along the Bush

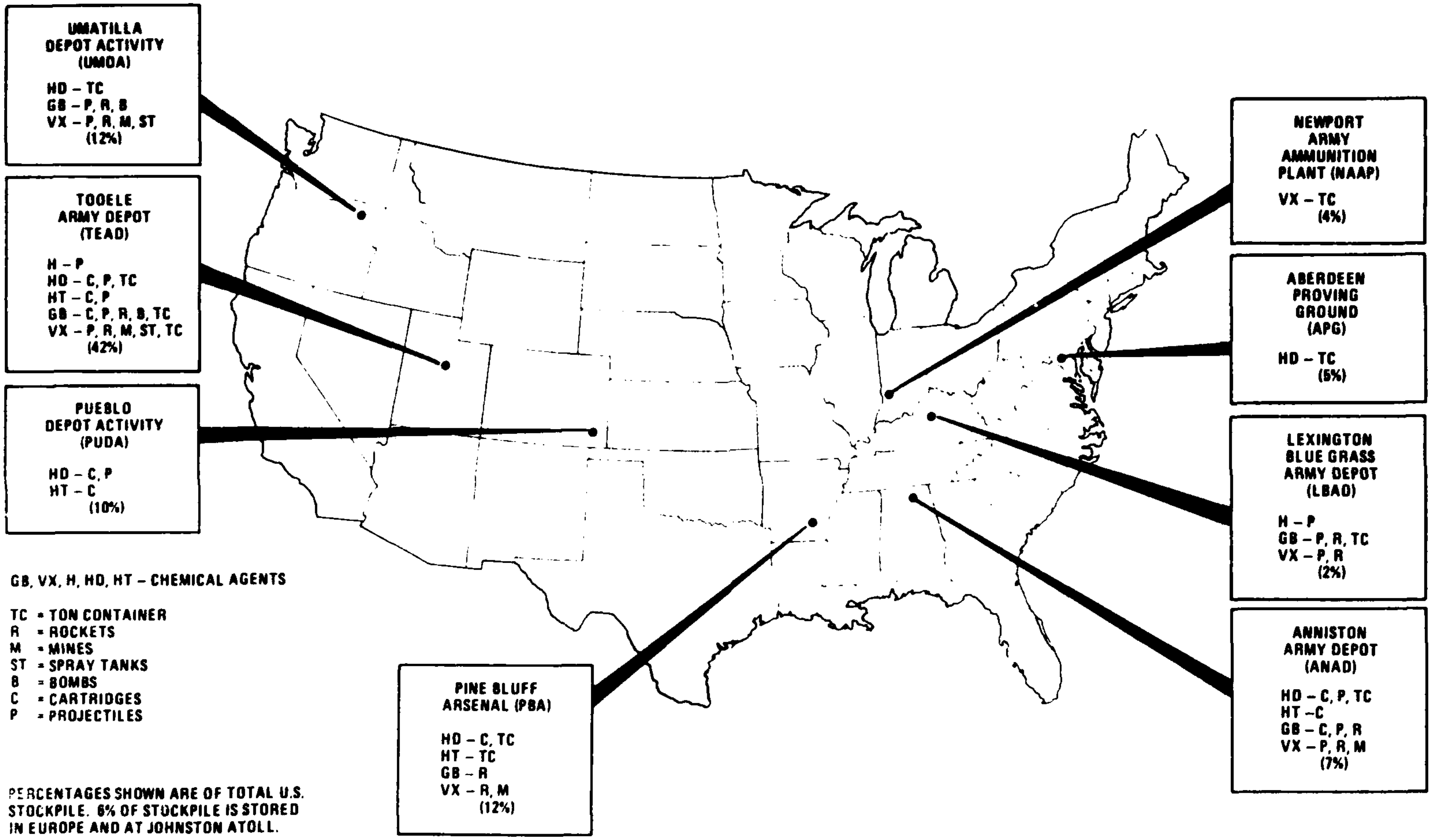


Fig. D-1. Location of chemical agents and munitions in the U.S.

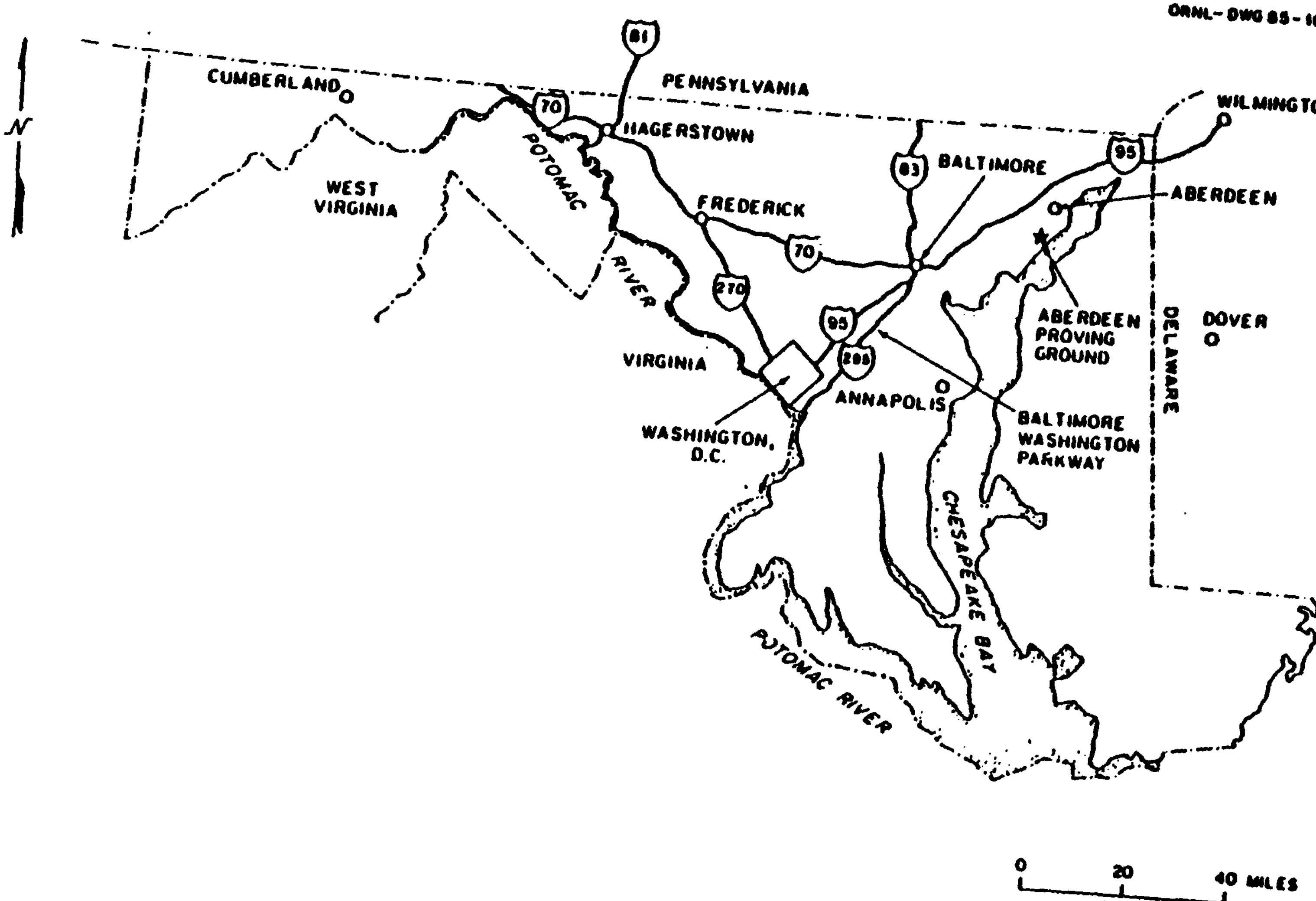
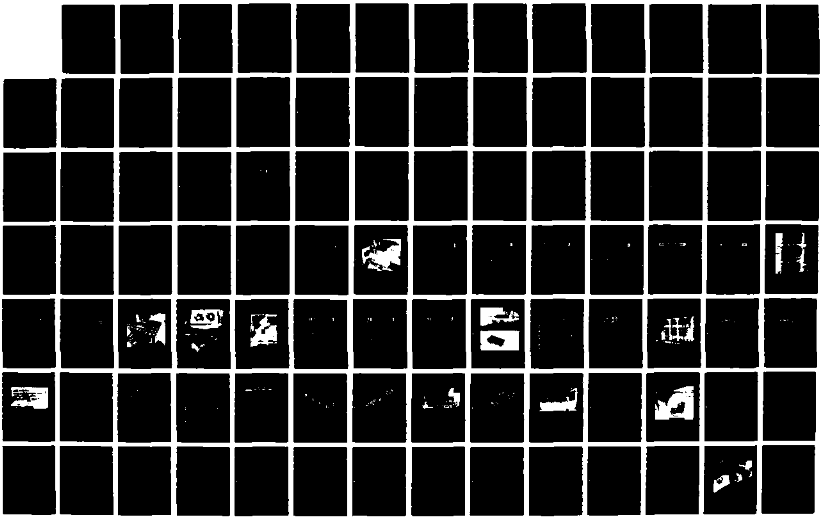
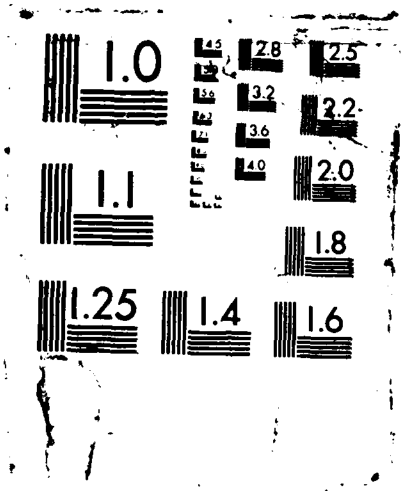


Fig. D-2. Maryland state map showing the location of APG

AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO CA A W BARSELL ET AL. AUG 87 GA-C-18563 10/13

UNCLASSIFIED SAPEO-CDE-IS-87006 DAAA15-85-D-0022 F/G 15/6.3 NL




1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

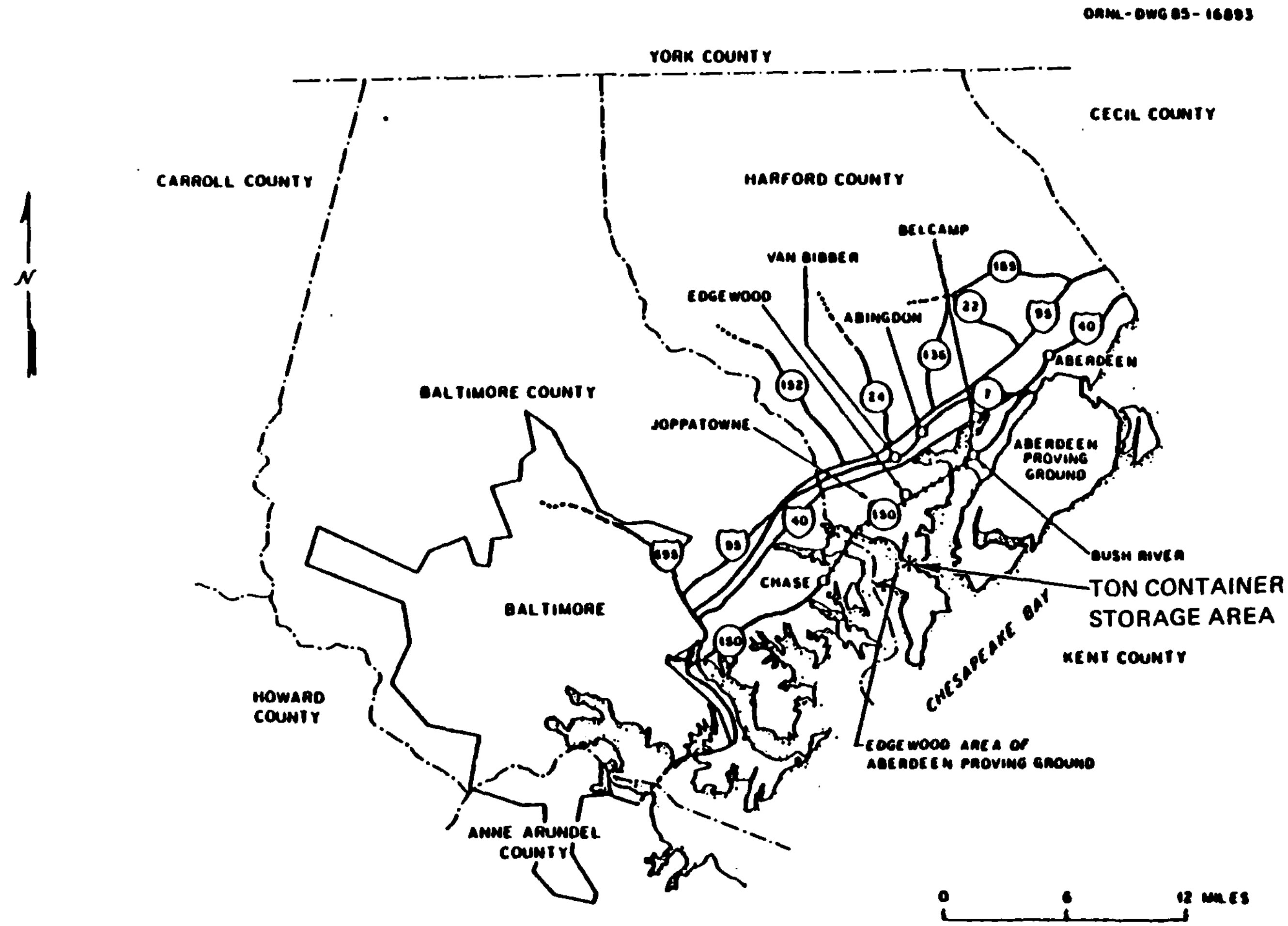


Fig. D-3. County map showing the location of APG

TABLE D-1
EARTHQUAKES IN THE VICINITY OF THE APG SITE
(Ordered By Distance From Site)

Year	Month	Day	Location	MMI	Distance from Site (km)
1883	3	11	39.5N, 76.4W	V	14
1883	3	12	39.5N, 76.4W	V	14
1883	3	12	39.5N, 76.4W	III	14
1883	3	12	39.5N, 76.4W	V	14
1939	6	22	39.5N, 76.6W	III	28
1939	11	18	39.5N, 76.6W	IV	28
1939	11	26	39.5N, 76.6W	V	28
1930	11	01	39.1N, 76.5W	IV	38
1930	11	01	39.1N, 76.5W	III	38
1906	10	13	39.2N, 76.7W	III	41
1910	04	24	39.2N, 76.7W	III	41
1758	04	25	38.9N, 76.5W	V	58
1876	01	30	38.9N, 76.5W		58
1978	07	16	39.9N, 76.2W	V	58
1984	04	19	39.9N, 76.3W	V	58
1984	04	23	39.9N, 76.3W	V	58
1910	01	24	39.6N, 77.0W	II	64
1828	02	24	38.9N, 76.7W		65
1978	10	06	39.9N, 76.5W	VI	66
1885	03	09	40.0N, 76.3W	IV	67
1939	04	02	40.0N, 76.3W	II	67
1971	07	14	39.7N, 75.6W	IV	69
1971	12	29	39.7N, 75.6W	IV	69
1972	01	02	39.7N, 75.6W	IV	69
1972	01	03	3917N, 75.6W	IV	69
1972	01	07	39.7N, 75.6W	IV	69
1972	01	22	39.7N, 75.6W	IV	69
1972	01	23	39.7N, 75.6W	IV	69
1972	01	23	39.7N, 75.6W	IV	69
1972	02	11	39.7N, 75.6W	V	69
1972	02	11	39.7N, 75.6W		69
1972	08	14	39.7N, 75.6W	IV	69
1972	08	14	39.7N, 75.6W		69
1974	04	28	39.7N, 75.6W	IV	69
1889	03	08	40.0N, 76.0W	V	71
1889	03	09	40.0N, 76.0W		71
1871	10	10	39.6N, 75.5W	IV	72
1879	03	26	39.2N, 75.5W	V	72
1902	03	10	39.6N, 77.1W	III	72
1902	03	11	39.6N, 77.1W	III	72
1903	01	01	39.6N, 77.1W	I	72
1983	11	17	39.8N, 75.6W	V	73
1983	12	12	39.8N, 75.6W		73
1871	10	09	39.7N, 75.5W	VII	76
1902	03	10	39.6N, 77.2W	III	80
1902	03	11	39.6N, 77.2W	III	80
1903	01	01	39.6N, 77.2W	III	80
1903	01	01	39.6N, 77.2W	II	80

Data provided by the National Geophysical Data Center, NOAA.

River. The storage yard consists of a central aisleway of finished concrete and the ton containers are secured over a gravel surface. There are two buildings in the CASY that are used to store equipment. Only mustard-filled ton containers are stored at APG and they are stored outdoors in accordance with AMC regulations.

The airspace above the Edgewood area of APG is continuously restricted (Restriction No. R-4001A). Permission to fly at altitudes above 10,000 ft from midnight to 7:00 AM may be requested 24 hr in advance. The Weide Army Air Field (AAF) is located within a mile of the storage area. It has a 4600-ft runway which is used by a general aviation flying club and an Air National Guard helicopter unit located at Weide AAF. The Army estimates that there are approximately 2600 general aviation operations (takeoffs/landings), 7200 helicopter operations, and 800 small fixed-wing military operations per year at Weide. There are no large aircraft operations.

Phillips AAF is located approximately 8 miles to the northeast. It has three runways. The longest is 8000 ft. The Army indicates that the edges of the approach and holding patterns for Phillips are more than 2 miles north of the storage area. Therefore, they are not considered a threat to the storage area per the guideline of Ref. D-3.

There are three other airports located in the area. Baltimore Airpark is approximately 8 miles to the west and has one 2200-ft runway. Martin State Airport is located 8 miles to the southeast. It has three runways. The longest is 7000 ft. The largest airport in the area is Baltimore Washington International Airport which is 26 miles southwest of Aberdeen. Its longest runway is 9500 ft. There are two low altitude federal airways (V378 and V499) that pass approximately 8 miles from the storage area. The closest high altitude jet routes (J42-8 and J40) are approximately 14 miles from the storage area. These airports and airways are not expected to present a significant threat to the storage

area because of the distances involved and because the storage area is protected by the restricted airspace.

D.1.2. ANNISTON ARMY DEPOT

As shown in Figs. D-4 and D-5, the Anniston Army Depot (ANAD) is located within Calhoun County in northeast Alabama adjacent to Fort McClellan, another active U.S. Army installation. ANAD is a major supply, stock distribution, and storage depot for general and strategic material, equipment, and supplies, including ammunition. Its functions also include maintenance and disposal activities associated with ammunition supply and storage, such as ammunition preservation, demilitarization, surveillance and training.

The chemical storage area at ANAD is located along the northeastern edge of the installation. The chemical storage area is divided into two adjacent areas, G-block and C-block. The ANAD chemical munition stockpile consists of all munition types except bombs and spray tanks. Munitions are stored in 40-ft, 60-ft, and 80-ft igloos. All 40-ft and 60-ft igloos are equipped with a single door, while all 80-ft igloos are equipped with a double door. The igloos are well maintained with no evidence of chronic structural problems. All igloos were re-waterproofed in 1984. The re-waterproofing involved removing the earthen covering over the igloo and sealing the concrete surface with tar. The earthen cover was then replaced to specifications.

The stockpile of chemical munitions stored at ANAD includes 105-mm cartridges, 4.2-in. mortars, 155-mm and 8-in. projectiles, 115-mm rockets, land mines, and ton containers. Documentation indicates that all of the 105-mm projectiles are stored in the cartridge configuration, packaged two cartridges per box. All munitions are stored in their standard configurations in accordance with AMC regulations.

As shown in Table D-2, five earthquakes of MMI levels V to VII have occurred in the vicinity of the ANAD site in this century.

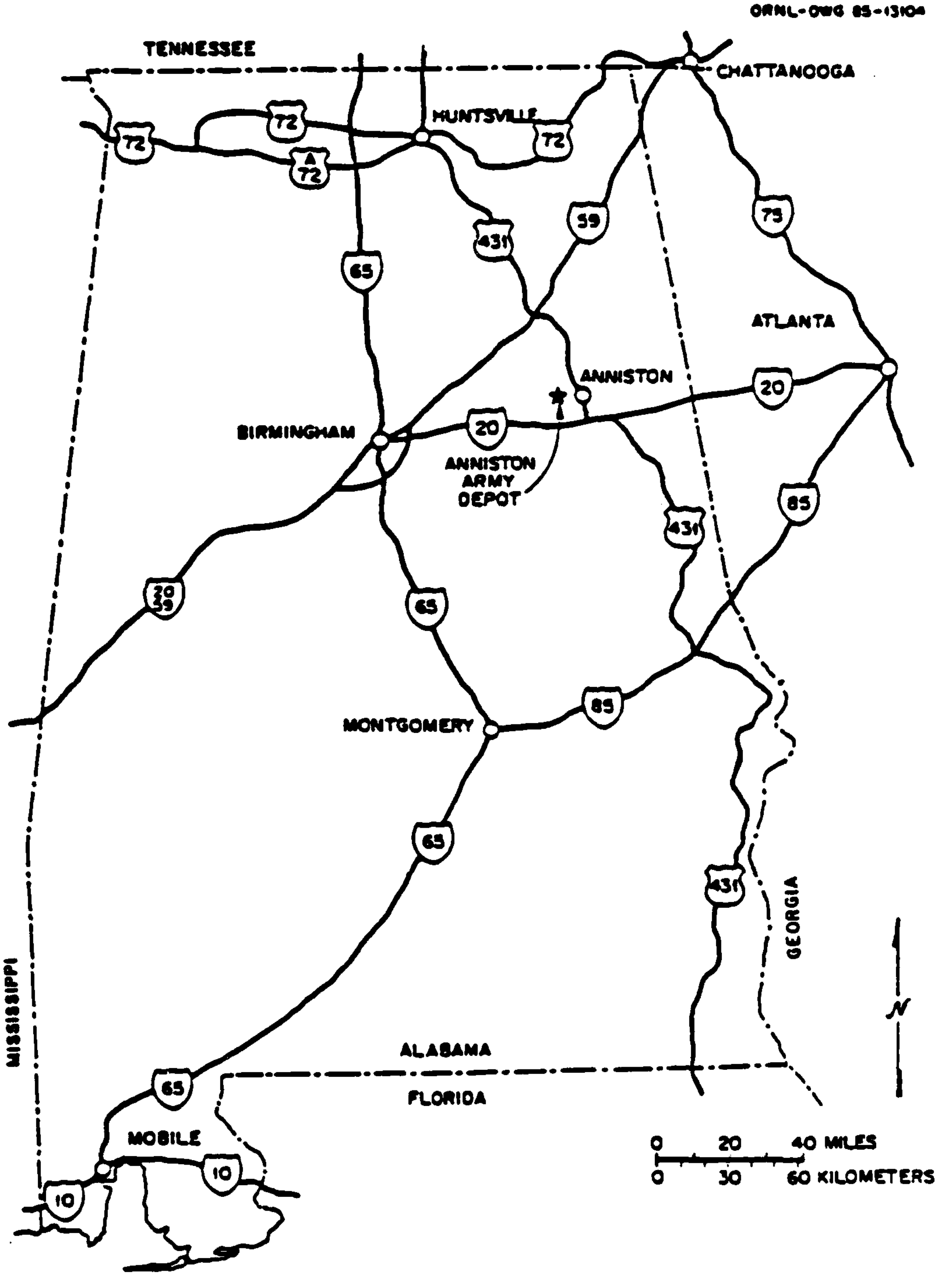


Fig. D-4. Alabama state map showing the location of ANAD

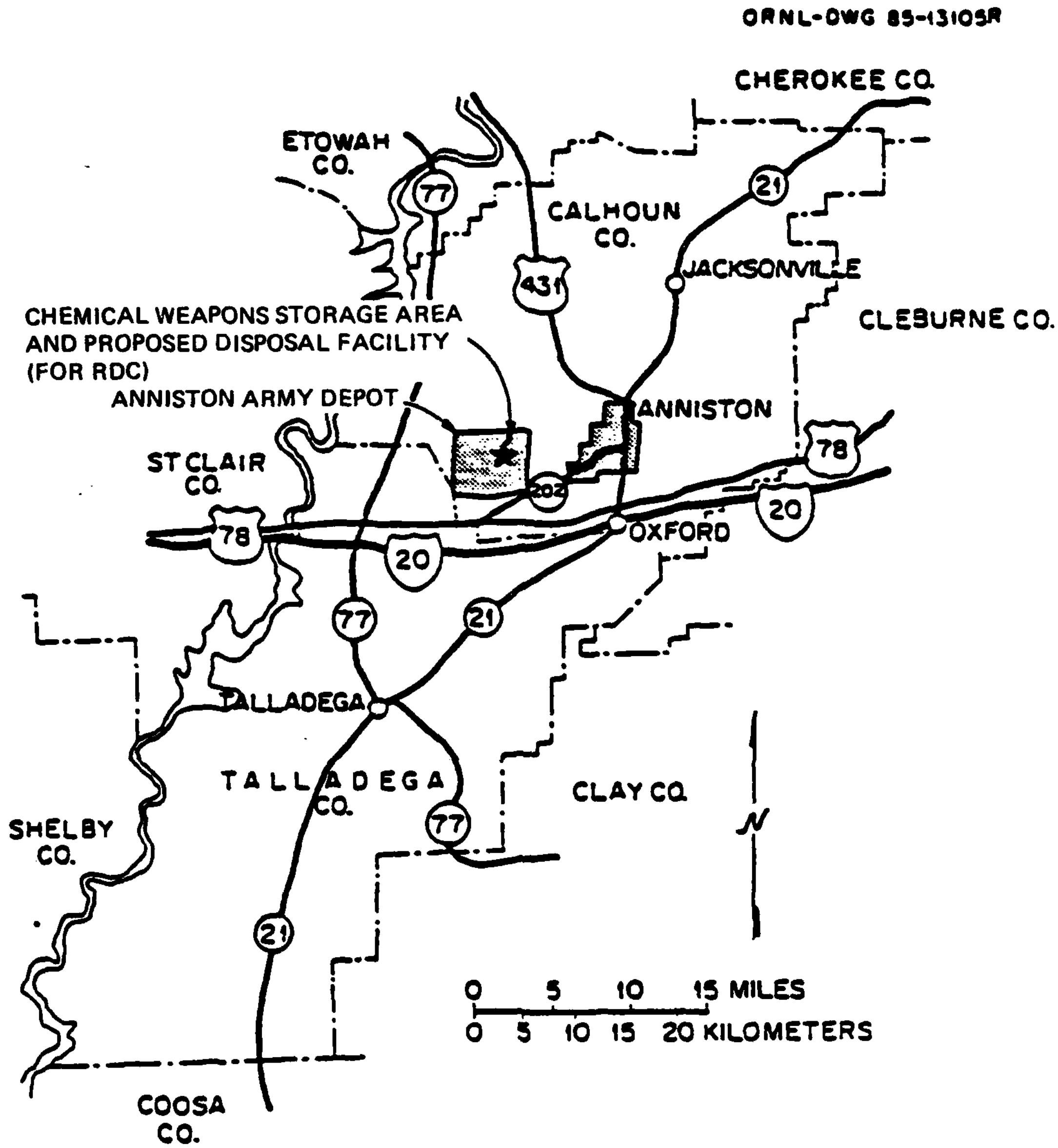


Fig. D-5. County map showing the location of ANAD

TABLE D-2
EARTHQUAKES IN THE VICINITY OF THE ANAD SITE[a]
(Chronological Listing)

Year	Month	Day	Location	Epicentral Intensity (MMI)
1916	10	18	Irondale, AL 33.5N, 86.2W	VII
1927	6	16	Scottsboro, AL 34.7N, 86.0W	V
1931	5	5	Cullman, AL 33.7N, 86.6W	V to VI
1939	5	4	Anniston, AL 33.7N, 85.8W	V
1975	8	28	Northern, AL 33.8N, 86.6W	VI

[a]Earthquakes within a 50- to 60-mile radius of the Anniston site, abstracted from Table 2.5-2, Clinch River Breeder Reactor Plant Preliminary Safety Analysis Report. Source: Ref. D-1.

The airspace above the chemical munition storage area at the ANAD is unrestricted. The airspace just north and northeast of the chemical storage area is restricted continuously to 24,000 ft (Restriction number R-2102). The area just west of the chemical munition storage area is restricted up to a 5000-ft level from 7:00 AM to 6:00 PM Monday through Friday (Restriction number R-2101).

The closest major airfields are Anniston and Talladega, both of which are approximately 8 miles from the chemical munition storage area. Anniston has a 7000-ft runway and can accept aircraft as large as a Lockheed C-141. Air traffic flying in and out of Anniston must stay to the south of the depot (Ref. D-1). Talladega has a 6000-ft runway. It has handled Lockheed C-130s but cannot accept C-141s. Air traffic coming out of Talladega must stay west of the depot (Ref. D-1). Consequently, the edge of the flight path in and out of Anniston and out of Talladega is at least 2 miles from the storage area.

To the east and north of the city of Anniston, there are two small airports and a heliport, the closest of which is 8 miles from the storage area. Air traffic from these airports is not a significant threat to the storage area since there is 3 miles of restricted airspace between these airports and the storage area.

There is one low altitude federal airway (V18) which passes 6 miles south of the storage area and one high altitude jet route (J14-52) which passes directly above the storage area. The high altitude jet route is the preferred jet route for ai· traffic between Atlanta and Denver (Ref. D-2). Military training route IR69 passes over the storage area and then returns three miles south of the storage area.

D.1.3. LEXINGTON-BLUE GRASS ARMY DEPOT

As shown in Figs. D-6 and D-7, the Lexington-Blue Grass Army Depot (LBAD) is located in Madison County, south of Richmond, Kentucky. The primary mission of the depot is to operate a general supply and ammunition depot activity providing for the receipt, storage, issue, maintenance, demilitarization, and disposal of assigned commodities.

The chemical munition storage area at LBAD is located in the north central half of the Blue Grass facility. The chemical munition stockpile at LBAD consists of 8-in. projectiles, 155-mm projectiles, and M55 rockets. These munitions are stored in 89-ft oval-arch igloos. Seventy-five percent of the igloos were waterproofed in 1982. The procedure involved removing the earth covering the igloo to apply a layer of tar, and then replacing the earthen cover.

Table D-3 summarizes earthquake activity in the vicinity of the LBAD site.

LBAD airspace is not restricted. There are three small airfields in the vicinity of the depot: Madison County Airport, Berea Richmond Airfield, and Galla Airfield. Madison County Airport is approximately 9 miles from the storage area. At the Madison County Airport, there is a civilian flight school which operates light aircraft, ranging from single engine light planes up to twin engine aircraft. The flight school uses two training areas near the depot, one to the north and the other to the east. The Madison County airport has a 4000-ft runway. The Berea Richmond Airfield is approximately 6 miles from the storage area and can support only light aircraft on its 2400-ft grass strip runway. Galla is a small, private airfield 12 miles east of the storage area. The air traffic from these airports over the storage area is not expected to be a significant hazard.

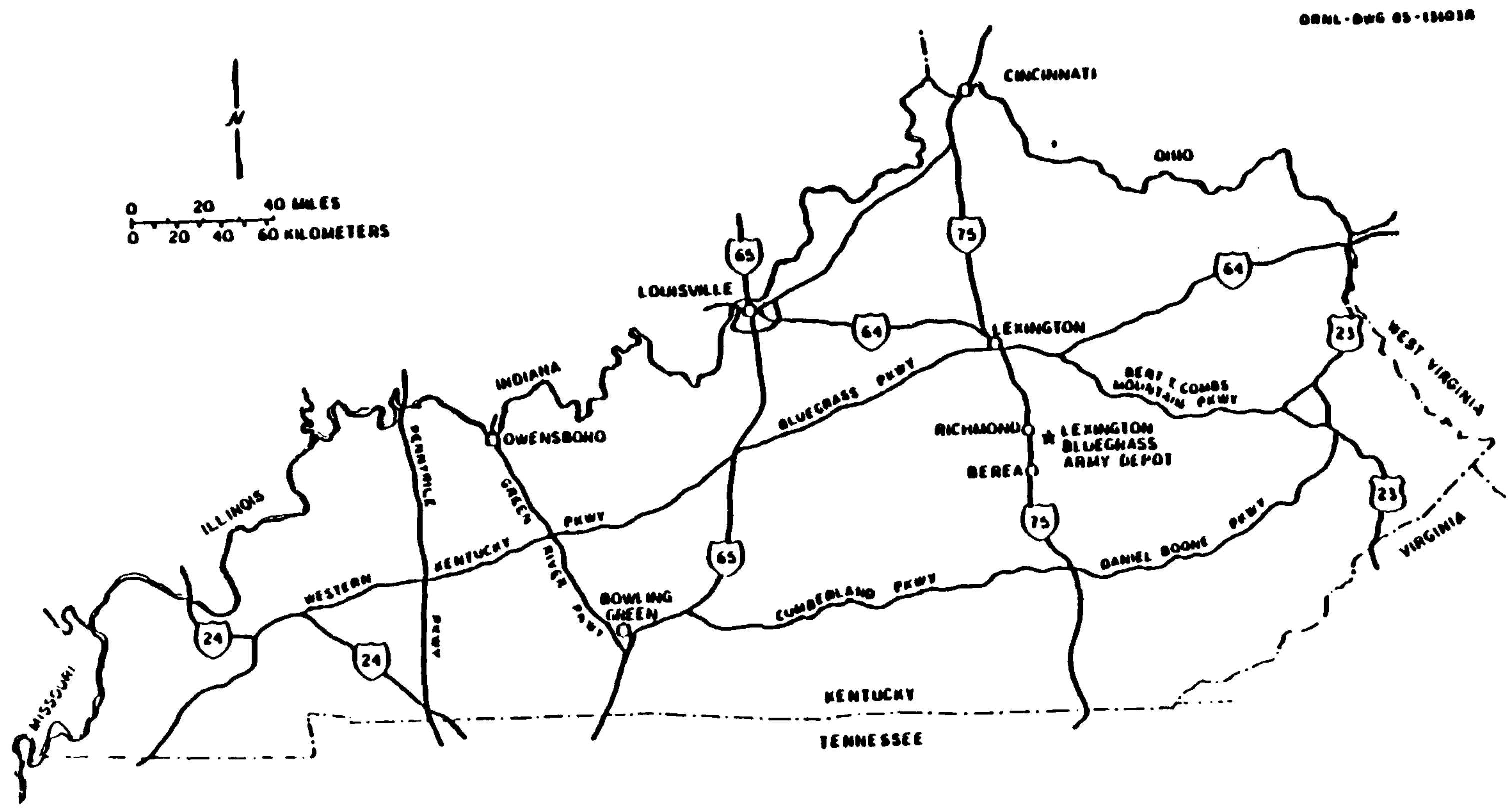


Fig. D-6. Kentucky state map showing the location of LBAD

ORNL-DWG 85-11165R3

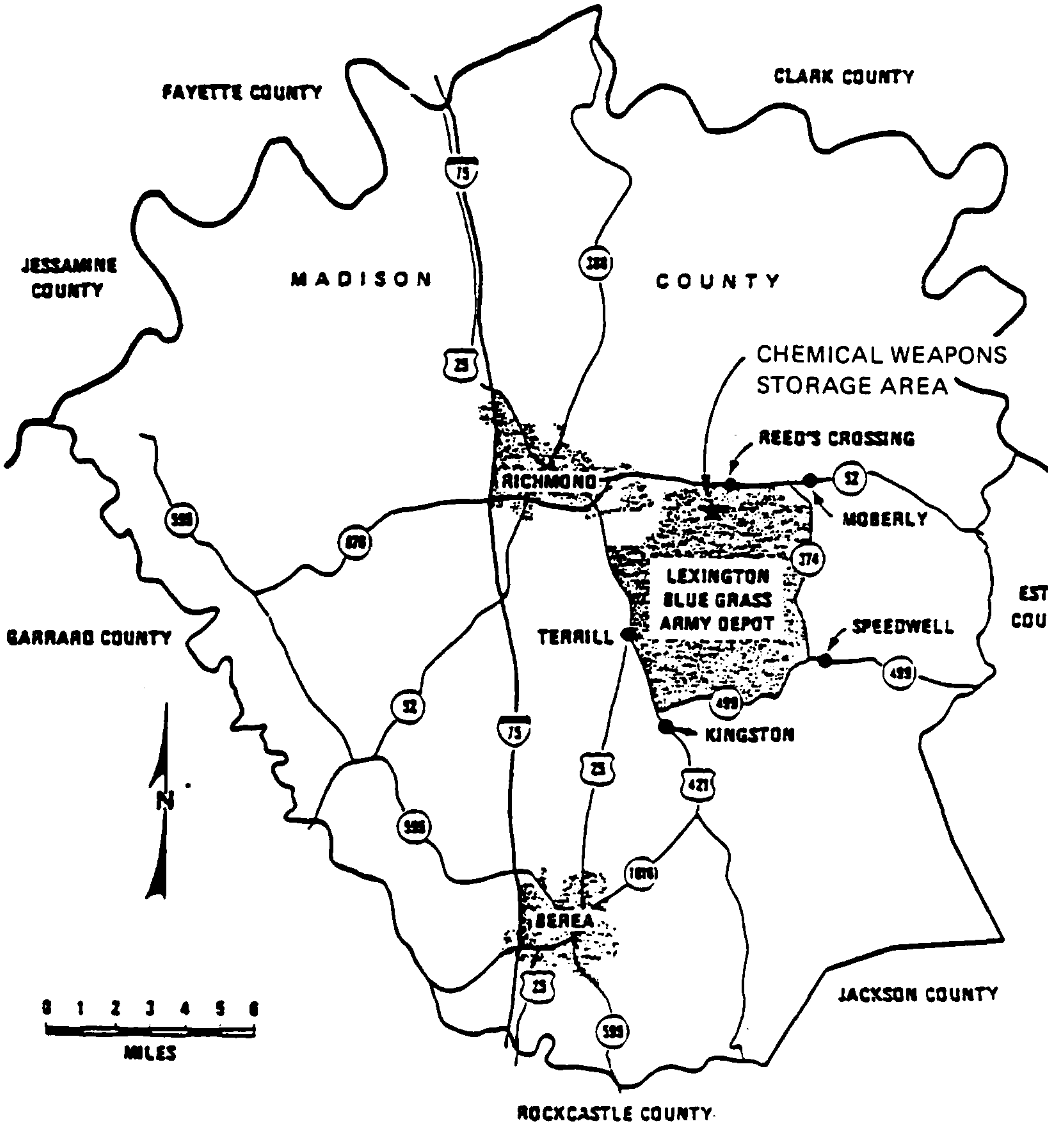


Fig. D-7. Madison county map showing the location of LBAD

TABLE D-3
EARTHQUAKES IN THE VICINITY OF THE LBAD SITE[a]
(Chronological Listing)

Year	Month	Day	Location	Epicentral Intensity (MMI)
1779	1	1	Kentucky 38.0N, 84.0W	Unknown
1834	11	20	Northern KY 37.0N, 86.0W	V
1933	5	28	Maysville, KY 38.7N, 83.7W	V
1954	1	1	Middlesboro, KY 36.6N, 83.7W	VI
1968	12	11	Louisville, KY 38.0N, 85.5W	V
1974	6	4	Kentucky 38.6N, 84.77W	V (est)
1976	1	19	Kentucky 36.88N, 83.82W	VI
1979	11	9	NE Kentucky 38.42N, 82.88W	V (est)
1980	6	27	Kentucky 38.17N, 83.91W	VII
1980	8	2	Kentucky 37.99N, 84.92W	III
1980	8	22	Kentucky 37.99N, 84.92W	III

[a] Earthquakes within a 50- to 60-mile radius of the Lexington-Blue Grass Site, abstracted from Table 2.5-2, Clinch River Breeder Reactor Plant Preliminary Safety Analysis Report. Source: Ref. D-1.

There is a U.S. Air Force radar bombing/scoring detachment stationed at the LBAD with frequent flights (10 to 11 aircraft per day) of Air Force B-52, F-4, and F-111 aircraft at low altitudes (750 and 3000 ft). The flights are active from 11:30 AM to 3:30 PM and from 6:00 PM until midnight every day. They fly at 750 ft under visual flight rules and at 2000 to 3000 ft under instrument rules with a visual observer. Generally, they make three simulated bombing runs per flight at distances at least 2 miles away from the chemical exclusion area. Per the guidelines of Ref. D-3, this is not expected to be a significant problem.

D.1.4. NEWPORT ARMY AMMUNITION PLANT

The Newport Army Ammunition Plant (NAAP) is located in west central Indiana, west of Indianapolis, as shown in Figs. D-8 and D-9. NAAP is operated by Mason & Hangar. The mission of NAAP is to (1) manufacture explosive and chemical materials, (2) fill chemical munitions, and (3) to store chemical munitions. Items 1 and 2 are currently inactive, while item 3 involves the activities associated with storage of VX chemical agent ton containers.

The chemical storage area at NAAP includes a single storage warehouse (Building 144) that is used to house VX ton containers. The storage building is approximately 79 ft wide and 279 ft long. The walls and roof of the building are of heavy gauge corrugated sheet metal, supported by steel beams.

The warehouse is in an exclusion area adjacent to the former VX production facility. The grounds within the exclusion area are all concrete or macadam covered surfaces. There are several large storage tanks that were used to store agent which are located along the southeast side of the warehouse. These storage tanks are currently empty. A 409-ft tall flash tower is located 450 ft to the east of Building 144. The flash tower was utilized during production of VX to burn several flammable gas by-products. Just outside the exclusion area, approximately 560 ft to the east of Building 144, is the site of a natural gas metering station. Natural gas was distributed to the production plant and to the area boiler from this point. Several empty storage vessels are located approximately 350 ft from the nearest ton containers outside the exclusion area. These tanks were used in conjunction with the former VX production facility. These tanks are to remain empty during the demilitarization campaign.

Table D-4 summarizes earthquake activity in the vicinity of the NAAP site.

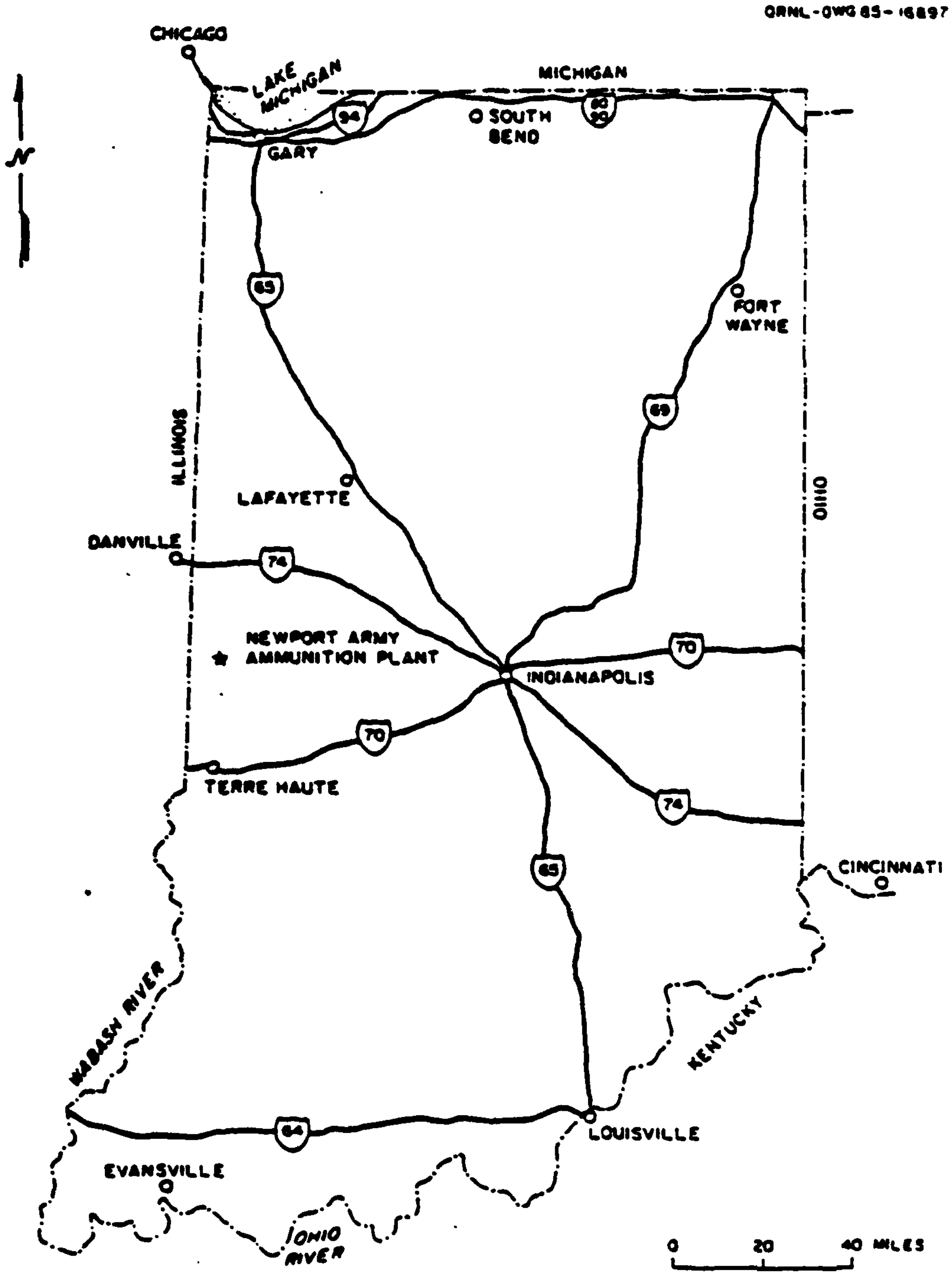


Fig. D-8. Indiana state map showing the location of NAAP

ORNL-DWG 85-16894

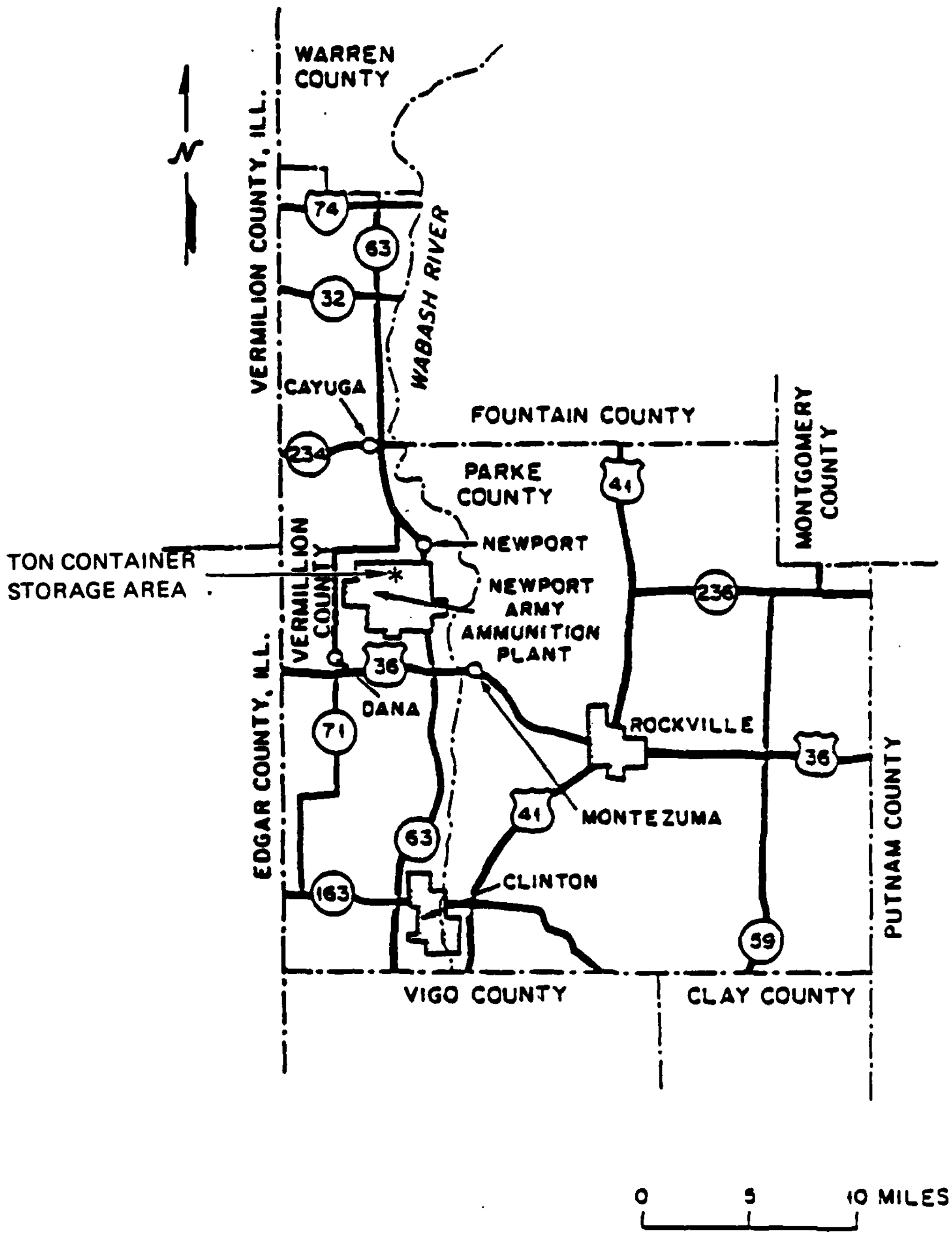


Fig. D-9. County map showing the location of NAAP

The airspace at NAAP is not restricted. The only airport within a 10-mile radius of the plant is a private airstrip (Rowe) with a 2600-ft runway located 8 miles west of the plant. The nearest public airport is Clinton which is approximately 12 miles south of the plant. Low altitude federal airway V171 passes 2 miles east of the storage area and airway V434 passes 5 miles north of the storage area. High altitude jet routes J80 and J73 cross over the storage area.

TABLE D-4
EARTHQUAKES IN THE VICINITY OF THE NAAP SITE
(Ordered By Distance From Site)

Year	Month	Day	Location	MMI	Distance from Site (km)
1909	9	27	39.5N, 87.4W	VII	41
1921	3	14	39.5N, 87.5W	IV	41
1903	12	31	40.0N, 87.9W		42
1974	11	25	40.3N, 87.4W	II	48
1906	7	13	39.7N, 86.8W		57
1906	8	13	39.7N, 86.8W	IV	57
1984	8	29	39.3N, 87.2W	V	58
1978	2	16	39.8N, 88.23W		68
1984	7	28	39.2N, 87.1W	V	78

Data provided by the National Geophysical Data Center, NOAA.

D.1.5. PINE BLUFF ARSENAL

As shown in Figs. D-10 and D-11, the Pine Bluff Arsenal (PBA) is located southeast of Little Rock, Arkansas and northwest of the city of Pine Bluff, Arkansas. The primary missions include storage of conventional and chemical munitions, destruction of nontoxic chemicals, and production of smoke munitions, white phosphorus projectiles and other incendiary devices. Future responsibilities include demilitarization of the BZ stockpile and production of binary chemical munitions.

The chemical storage area at PBA is located in the northwestern section of the installation. The following munitions are stored at PBA: 4.2-in. mortar projectiles, M55 rockets, land mines, and ton containers. All munitions except ton containers are stored in 80-ft igloos. Ton containers containing mustard agent are stored outdoors in a fenced area within the chemical storage area. The ton containers are strapped to railroad rails and stacked one high per AMC regulations.

Table D-5 summarizes earthquake activity in the vicinity of the PBA site.

PBA airspace is not restricted. The closest important airfield, Grider Field, is about 16 miles southeast of the chemical munition storage area. There are three smaller airfields which are closer (10 to 14 miles). Because of the relatively significant distances from airfields, PBA is not considered to have a significant hazard due to airfield operations.

Grider handles approximately 115 aircraft movements per day, seven days a week. About 95% of this traffic is corporate/civilian, and the remainder is military. The runway at Grider Field is 6,000 ft and can occasionally accommodate commercial 727 and military C-141 aircraft. Low altitude federal airways V74, V305, and V16 pass within 7, 10, and 11 miles, respectively. High altitude airway J42 passes over the site.

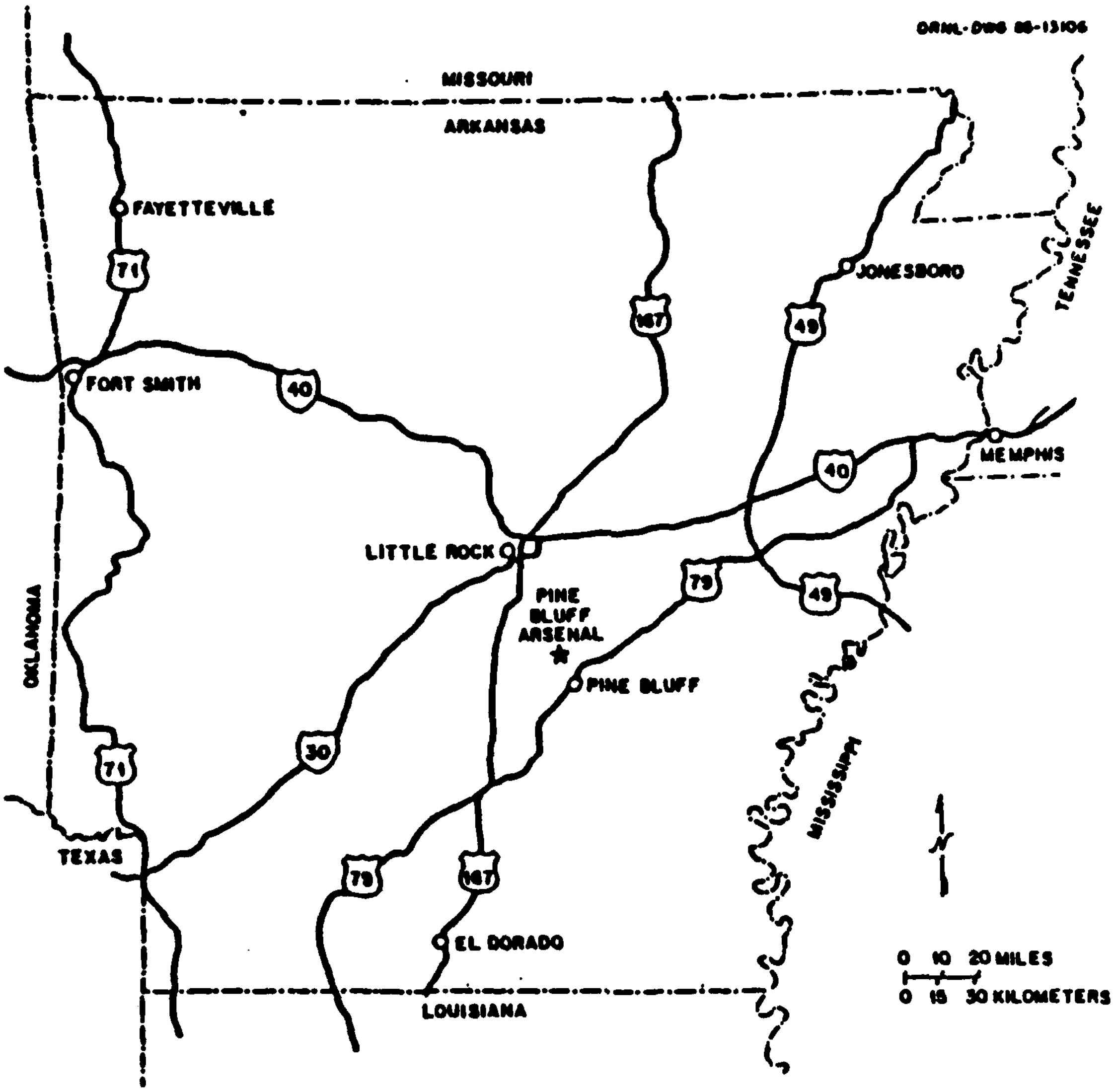


Fig. D-10. Arkansas state map showing the location of PBA

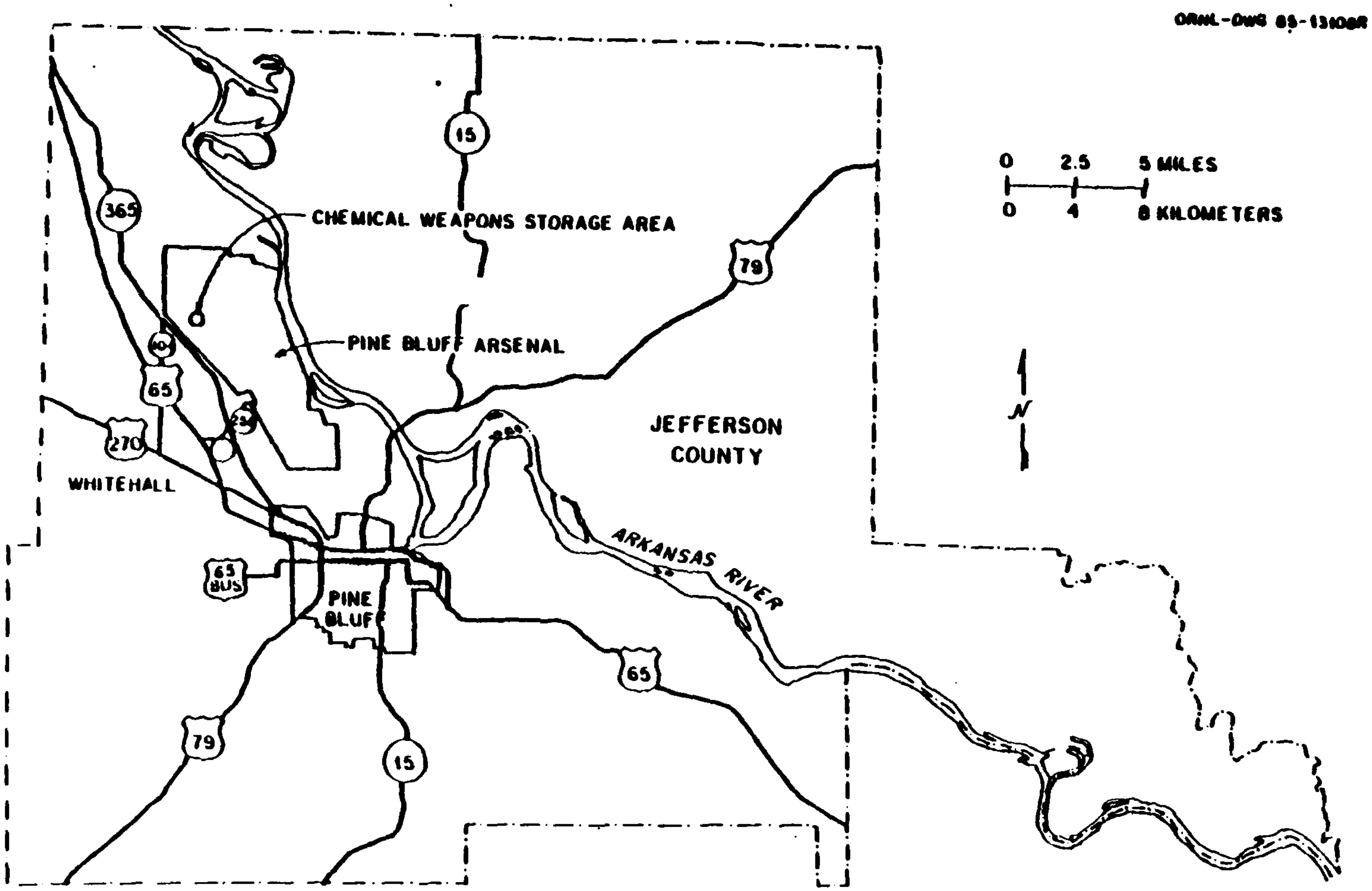


Fig. D-11. County map showing the location of PBA

There is a helipad onsite about 2 miles away from the chemical munition storage area boundary. The flight frequency was estimated to be 30 or less flights a month (Ref. D-1).

TABLE D-5
EARTHQUAKES IN THE VICINITY OF THE PBA SITE[a]
(Chronological Listing)

Year	Month	Day	Location	Epicentral Intensity (MMI)
1911	3	31	33.8N, 92.2W	VI
1918	10	4	34.7N, 92.3W	V
1930	11	16	34.3N, 92,8W	V
1939	6	19	34.1N, 93.1W	V
1967	6	4	33.5N, 90.8W	VI
1967	6	29	33.5N, 90.8W	V
1969	1	1	34.3N, 92.6W	VI
1974	2	15	33.9N, 93.0W	V
1974	12	13	34.5N, 91.8W	V
1978	9	23	33.6N, 91.89W	V
1982	1	21	35.1N, 92.2W	V
1982	1	24	35.2N, 92.2W	V
1982	2	24	35.1N, 92.2W	V
1982	3	1	35.1N, 92.2W	V
1983	1	19	35.1N, 92.2W	V

[a]Earthquakes within a 100 mile (160 km) radius of the Pine Bluff site as provided by the National Geophysical Data Center, NOAA. Records believed to be duplicates are reported only once. Source: Ref. D-1.

D.1.6. PUEBLO DEPOT ACTIVITY

The Pueblo Depot Activity (PUDA) is under the command of the Tooele Army Depot. As shown in Figs. D-12 and D-13, the installation lies east of the city of Pueblo, Colorado and north of the Arkansas River. The mission of PUDA facilities is to operate a reserve storage and maintenance function providing for (1) limited receipt, storage, and issue of assigned commodities; (2) depot maintenance of assigned commodities; (3) limited maintenance of facilities to prevent deterioration of the ammunition stockpile; (4) operation of a calibration service for an assigned geographical area; (5) demilitarization and disposal of deteriorated explosives and munitions; (6) ammunition surveillance; (7) small arms clipping and linking; (8) operation of the Function/Trace Test Range; and (9) missile maintenance/production.

The chemical storage area at PUDA is located in the northeast corner of the depot in the G-block storage area. The following munitions are stored at PUDA: 155-mm projectiles, 105-mm cartridges and projectiles, and 4.2-in. mortar projectiles. All munitions are stored in 80-ft igloos.

Table D-6 summarizes earthquake activity in the vicinity of the PUDA site.

The airspace at the PUDA is not restricted. There is a private airport (Youtsey) a few miles south of the depot. The nearest public airport is Pueblo Memorial which is located 6 miles west of the boundary of the depot. This airport has four runways, the longest being 10,500 ft. Pueblo Memorial is used as a training airport for both commercial and military aircraft. Low altitude federal airways V10, V19, V81, V83, V244, and V389 all pass within a few miles of the depot, as do high altitude jet routes J17 and J28.

ORNL-DWG 85-16898

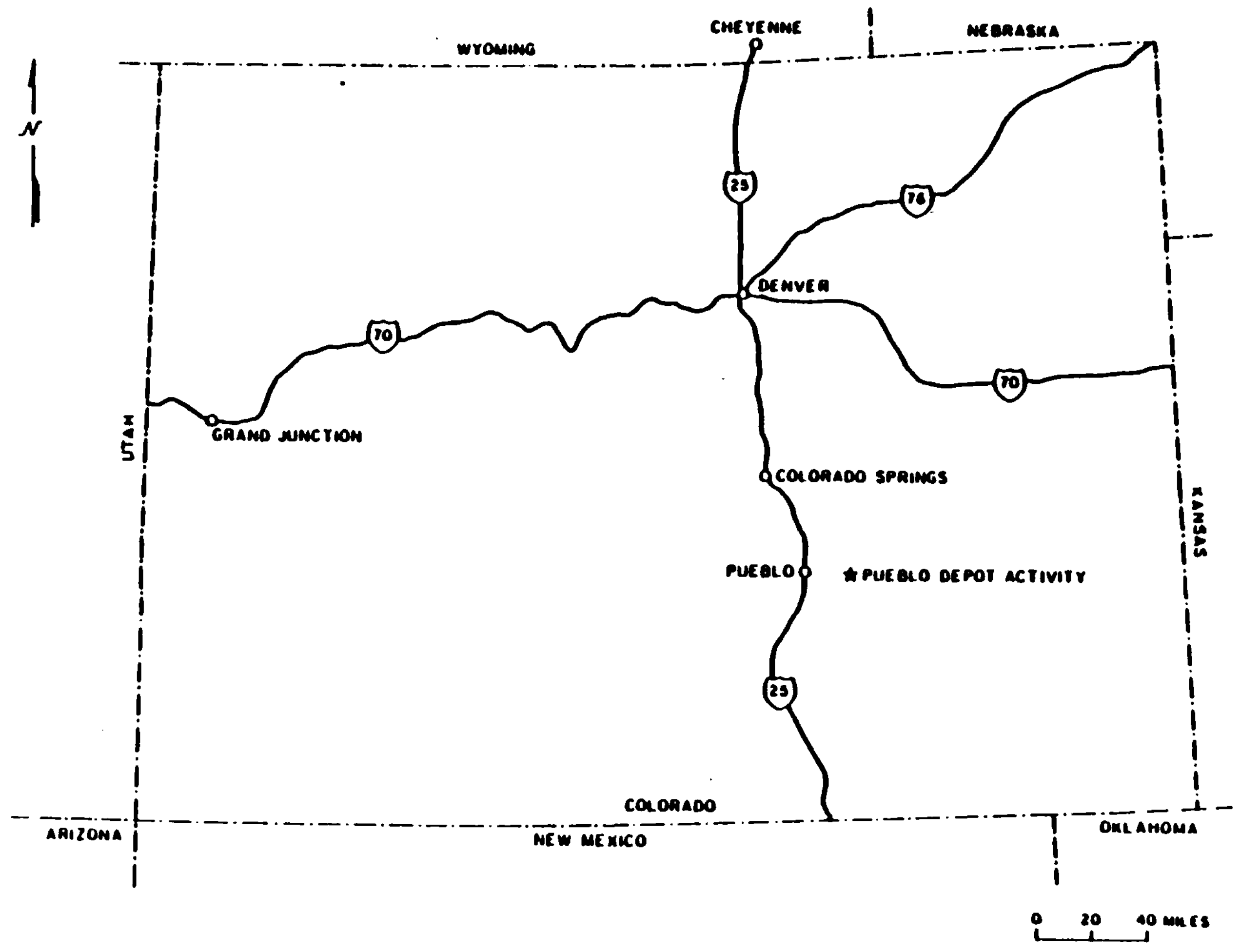


Fig. D-12. Colorado state map showing the location of PUDA

ORNL-DWG 85-16895

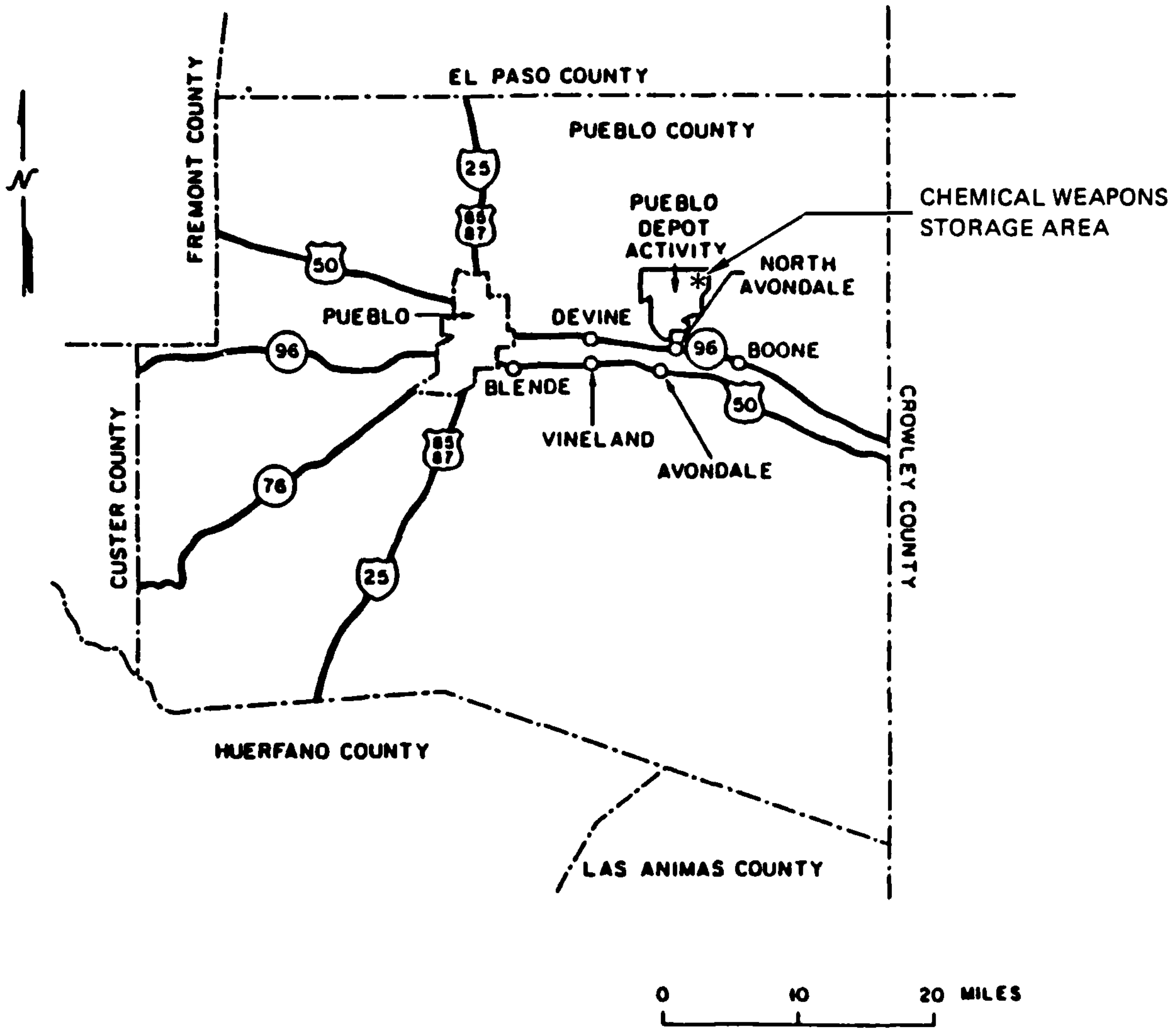


Fig. D-13. County map showing the location of PUDA

TABLE D-6
EARTHQUAKES IN THE VICINITY OF THE PUDA SITE
(Ordered By Distance From Site)

Year	Month	Day	Location	MMI	Distance from Site (km)
1963	11	13	38.3N, 104.6W	IV	22
1870	12	4	38.5N, 104.0W	VI	37
1955	11	28	38.2N, 103.7W	IV	58
1925	2	18	38.2N, 105.1W	IV	67
1888	10	23	38.1N, 105.2W	IV	78

Data provided by the National Geophysical Data Center, NOAA.

D.7. TOOELE ARMY DEPOT

The Tooele Army Depot (TEAD) is located in north central Utah southwest of Salt Lake City as shown in Figs. D-14 and D-15. The Army Depot consists of two separate areas, North and South. The chemical agent storage and demilitarization operations are located in the South Area. The mission of TEAD is to operate a supply depot providing for receipt, storage issue, maintenance and disposal of assigned commodities; and to operate other facilities such as the Chemical Agent Munitions Disposal System (CAMDS).

The chemical storage area at TEAD is located in the center of the south area. There are storage magazines, warehouse buildings, and several storage yards within the chemical agent exclusion area. The storage magazines include both 89-ft oval-arch magazines and 80-ft igloo magazines. M55 rockets, 155-mm and 8-in. projectiles, 105-mm cartridge projectiles, 4.2-in. mortar projectiles, GB and VX ton containers, M23 land mines, and weteye bombs are stored in the 80-ft igloos. MC-1 bombs, 155-mm and 105-mm projectiles are stored in the 89-ft oval-arch magazines. Ton containers containing mustard are stored outdoors. The two warehouse buildings currently are used to store VX spray tanks packaged inside TMU-28/B storage and shipping containers.

The warehouse buildings are flat-roofed, single-story structures approximately 188 ft long, 179 ft wide, and 16 ft high. Details of construction are shown in Army Corps of Engineers Drawing 201-25-65. The side walls of the buildings are single piece precast concrete panels 6 in. thick, 16 ft high, with widths varying around 30 ft. The roof is of corrugated sheet metal, supported by a steel beam support structure and steel box beam vertical support columns. The main beams are W24 x 68 steel I-beams with unsupported spans of about 30 ft. Open trusses are used to span between the main beams.

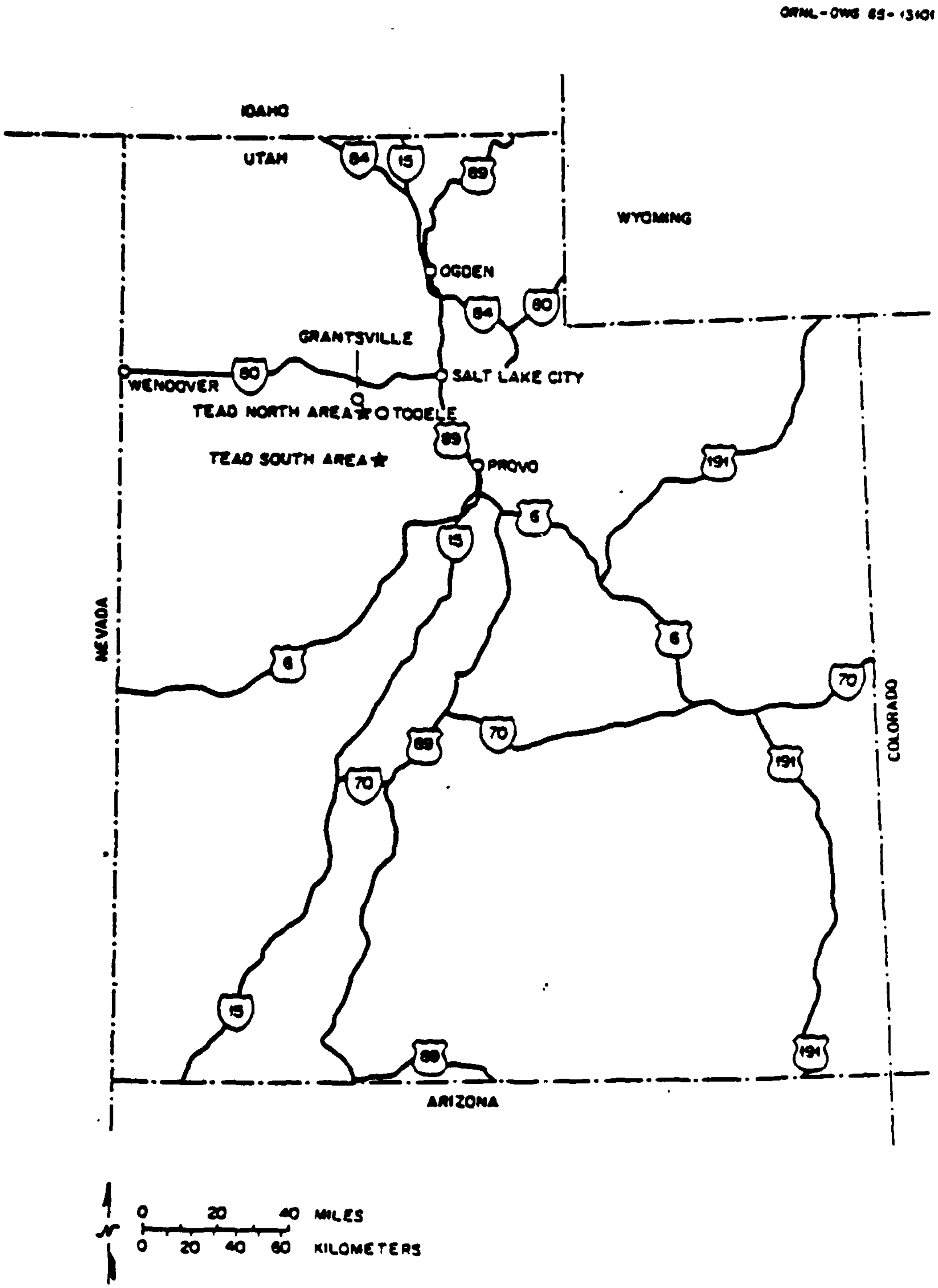


Fig. D-14. Utah state map showing the location of TEAD

ORNL DWG 85-13102R

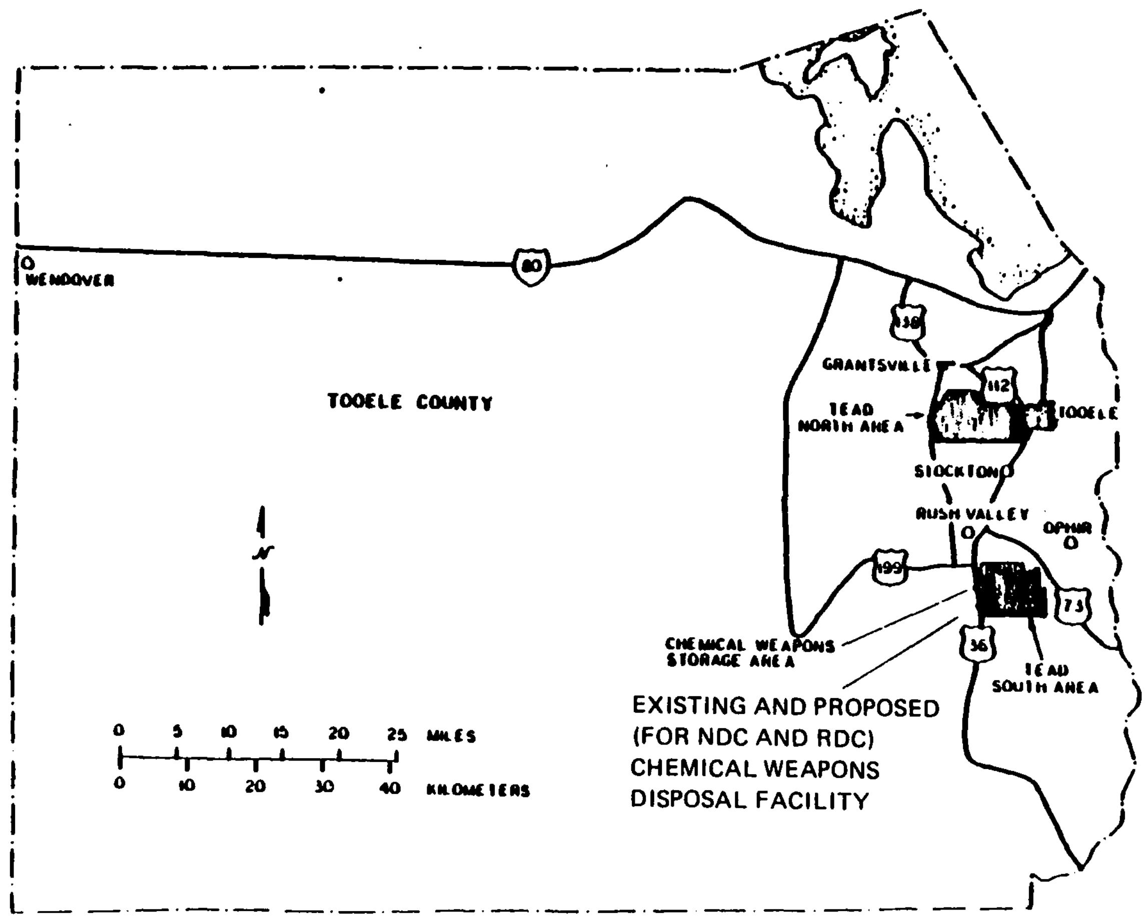


Fig. D-15. Tooele county map showing the location of TEAD

Table D-7 summarizes earthquake activity in the vicinity of the TEAD site.

The airspace over the TEAD South Area is not restricted but pilots are requested (for reasons of national security) to avoid flying below 6400 ft over this area for a radius of 3 nautical miles (3.5 statute miles).

Tooele Municipal Airport is the nearest airport to the site. It is located 14 miles north of the site and is not expected to present a significant hazard.

There are two low altitude federal airways in the vicinity of the TEAD South Area: V257, three miles to the west, and V253, 17 miles to the northeast. High altitude airways are not considered a hazard for this site.

There is a helipad located near the administrative building approximately 3 miles from the chemical munition storage area. The helipad is used infrequently. The number of flights per month is estimated to be 15.

TABLE D-7
EARTHQUAKES IN THE VICINITY OF THE TEAD SITE[a]
(Chronological Listing)

Year	Month	Day	Location	Epicentral Intensity (MMI)
1853	12	1	39.7N, 111.8W	V
1876	3	22	39.5N, 111.5W	VI
1880	9	17	40.8N, 112.0W	V
1884	11	10	40.8N, 111.9W	VIII
1894	1	8	39.7N, 113.4W	V
1894	6	8	39.9N, 113.4W	V
1894	7	18	41.2N, 112.0W	VII
1899	12	13	41.0N, 112.0W	V
1900	8	1	39.8N, 112.2W	VII
1906	5	24	41.2N, 112.0W	V
1909	11	17	41.7N, 112.2W	V
1910	5	22	40.8N, 111.9W	VII
1914	4	8	41.2N, 111.6W	V
1915	7	15	40.3N, 111.7W	VI
1915	7	30	41.7N, 112.1W	V
1915	8	11	40.5N, 112.7W	V
1915	10	5	40.1N, 114.0W	V
1916	2	5	40.0N, 111.7W	V
1920	9	18	41.5N, 112.0W	VI
1920	9	19	41.5N, 112.0W	VI
1920	11	20	41.5N, 112.0W	VI
1934	3	12	41.5N, 112.5W	VIII
1934	4	14	41.5N, 112.5W	
1934	5	6	41.7N, 113.0W	
1938	7	9	40.5N, 111.6W	V
1938	6	30	40.5N, 111.6W	VI
1943	2	22	40.4N, 111.8W	VI
1947	3	7	40.5N, 111.6W	V
1949	3	7	40.5N, 111.6W	V
1950	5	8	40.0N, 111.5W	V
1951	8	12	40.2N, 111.4W	V
1952	9	28	40.3N, 111.5W	V
1953	5	24	40.5N, 111.5W	VI
1955	2	4	40.5N, 111.6W	V
1955	5	12	40.4N, 111.6W	V
1958	2	13	40.5N, 111.5W	VI
1958	11	28	39.4N, 111.5W	V
1958	12	1	40.5N, 112.5W	V
1958	12	2	40.5N, 112.5W	V
1961	4	16	39.1N, 111.5W	VI
1962	9	5	40.7N, 112.0W	VI
1963	7	7	39.6N, 111.9W	VI
1963	7	9	40.0N, 111.2W	
1963	7	10	39.9N, 111.4W	V
1965	5	11	41.0N, 111.5W	

TABLE D-7 (Continued)

Year	Month	Day	Location	Epicentral Intensity (MMI)
1966	5	23	39.2N, 111.4W	
1967	2	16	41.3N, 113.3W	V
1967	9	24	40.7N, 112.1W	V
1967	12	7	41.3N, 111.7W	V
1968	1	16	39.3N, 112.2W	V
1968	11	17	39.5N, 110.9W	V
1969	5	23	39.0N, 111.8W	V
1970	4	14	39.6N, 110.7W	V
1970	10	25	39.1N, 111.3W	V
1972	10	1	40.5N, 111.3W	VI
1972	10	16	40.4N, 111.0W	V
1973	7	16	39.1N, 111.5W	V
1977	11	28	41.3N, 111.6W	V
1978	2	28	40.7N, 112.2W	V
1978	3	9	40.7N, 112.0W	VI
1978	3	13	40.7N, 112.0W	V
1980	5	24	39.9N, 111.9W	V
1981	2	20	40.3N, 111.7W	V
1981	5	14	39.4N, 111.0W	V
1983	10	8	40.7N, 111.9W	VI

[a]Earthquakes within a 100-mile radius of TEAD as provided by the National Data Center, NOAA. Records believed to be duplicated are reported only once. Source: Ref. D-1.

D.1.8. UMATILLA DEPOT ACTIVITY

The Umatilla Depot Activity (UMDA) is under the command of TEAD. As shown in Figs. D-16 and D-17, the installation is located in Umatilla and Marrow Counties in northeastern Oregon, near the south shore of the Columbia River, west of Hermiston, Oregon. UMDA's mission is to operate a reserve storage depot activity under the command of TEAD providing care and preservation for and minor maintenance of assigned commodities.

The storage area is located at the northern edge of the installation. Eighty-foot igloo magazines and warehouses are used to store the chemical munition stockpile of 155-mm and 8-in. projectiles, M55 rockets, M23 land mines, bombs, spray tanks, and ton containers. Warehouses are used to store ton containers containing mustard agent. The magazines are spaced 400 ft apart.

The warehouses are butler type buildings connected by a roof with a steel structure and aluminum siding (single sheet). The two buildings are defined as transitory structures, approximately 154 ft wide (total for both buildings) and 300 ft long.

Table D-8 summarizes earthquake activity in the vicinity of the UMDA site.

The UMDA airspace is not restricted. The nearest active airfield to the Umatilla site is Hermiston Municipal Airport approximately 12 miles from the depot. With one 4000-ft runway, its capabilities are limited to aircraft up to the size of corporate jets. The Tri-Cities Airport in Pasco, Washington, with a maximum runway length of 7700 ft, is approximately 30 miles from the depot. In general, it does not handle military aircraft. There is also a paved runway on the UMDA site capable of handling small aircraft up to the size of a Beech U-21 light utility aircraft. The nearest military airfields are in Spokane, Washington; Moses Lake, Washington; and Mt. Home, Idaho.

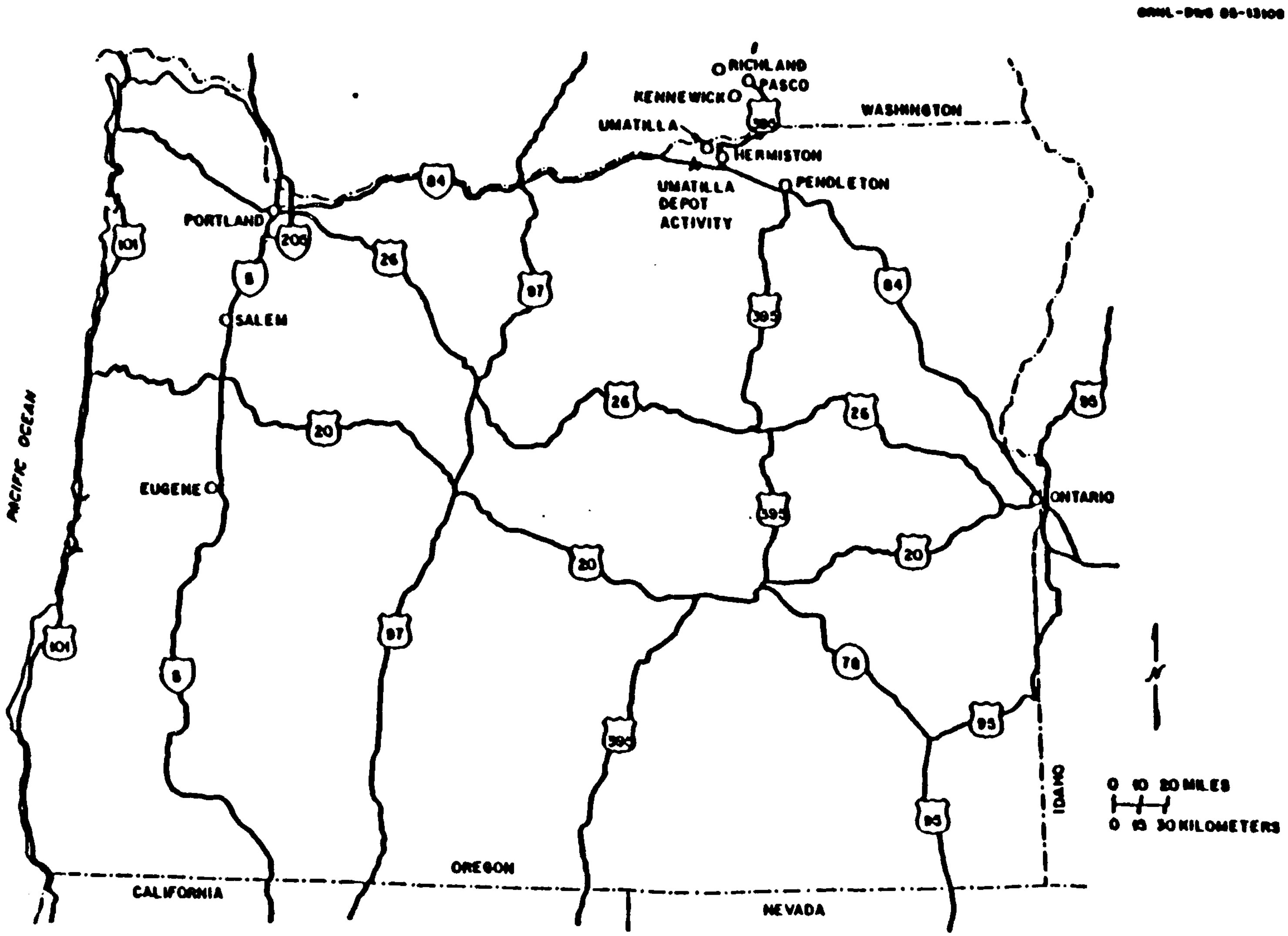


Fig. D-16. Oregon state map showing the location of UMDA

ORNL-DWG 85-13110R

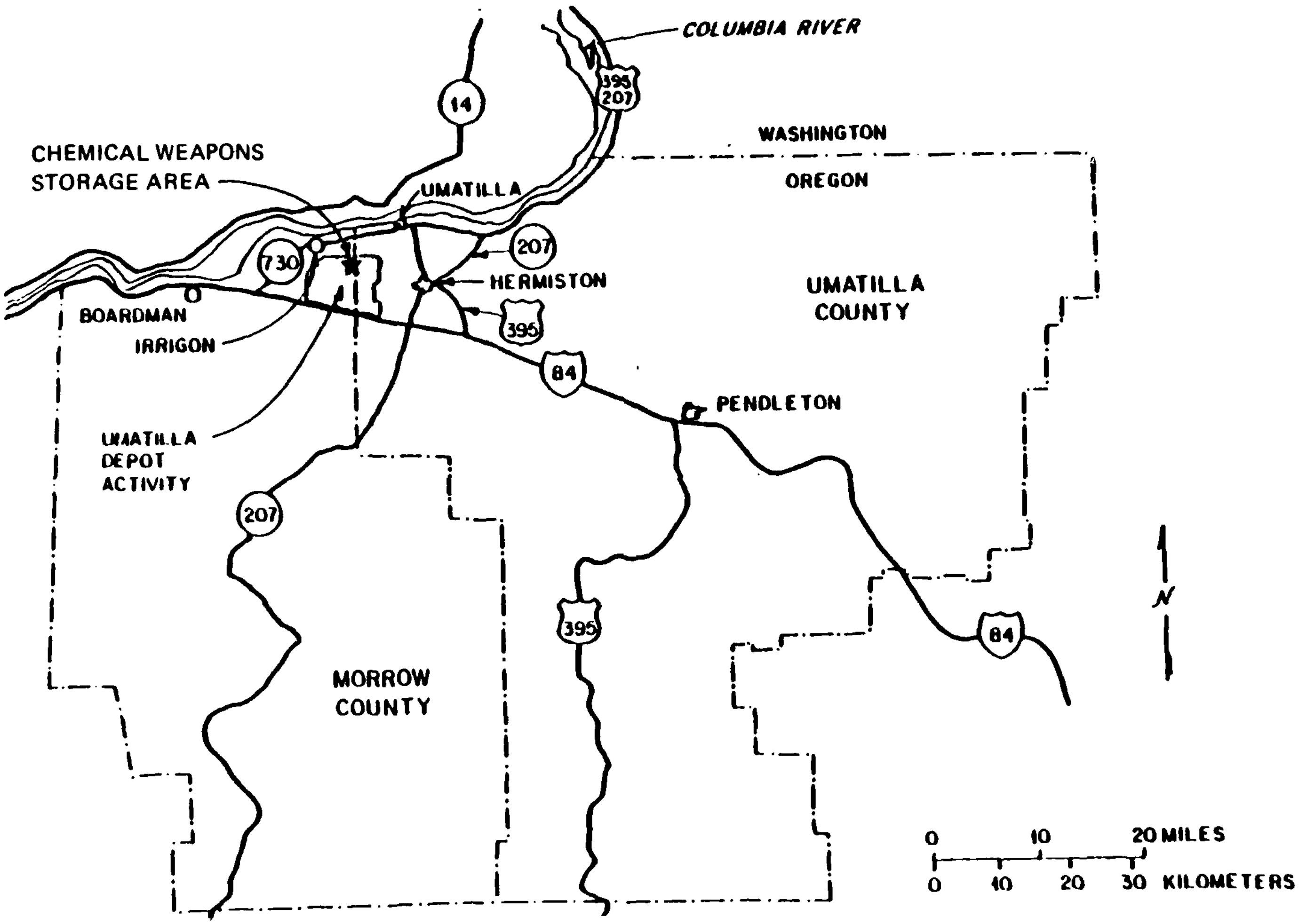


Fig. D-17. County map showing the location of UMDA

TABLE D-8
EARTHQUAKES IN THE VICINITY OF THE UMDA SITE[a]
(Chronological Listing)

Year	Month	Day	Location	Epicentral Intensity (MMI)
1893	3	5	Umatilla, OR	VI
1918	11	1	46.7N, 119.5W	V to VI
1921	9	14	Dixie, WA	V to VI
1924	1	6	Walla Walla, WA	IV
1924	1	6	Milton Weston, OR	V
1924	5	26	Walla Walla, WA	IV
1926	4	23	Walla Walla, WA	IV
1936	7	15	46.0N, 118.5W	VII
1936	7	18	46.0N, 118.3W	V
1936	7	20	Freewater, OR	IV
1936	8	4	45.8N, 118.6W	V
1936	11	17	Walla Walla, WA	III
1937	2	9	Walla Walla, WA	IV
1937	6	4	Walla Walla, WA	IV
1938	8	11	Milton, OR	IV
1938	10	27	Milton, OR	IV
1944	9	1	Walla Walla, OR	IV
1945	9	22	Walla, Walla, OR	IV
1951	1	7	McNary, OR	V
1959	1	20	Milton-Freewater, OR	V
1959	11	9	Heppner, OR	IV
1971	10	25	46.7N, 119.5W	IV

Earthquakes within a 50- to 60-mile radius of the Umatilla site, abstracted from Table 2.5-2, UNI-M-90, "N Reactor Updated Safety Analysis Report," United Nuclear Industries, Inc., February 28, 1978. Source: Ref. D-1.

The Medium Attack Tactical Electronic Warfare Wing bombing range is located 10 miles to the southwest of UMDA chemical munitions exclusion area. This area is a restricted airspace (Restriction numbers R-5701, R-5704, R-5706) in which the Navy holds bombing exercises. Grumman A-6 aircraft, in groups of four, fly about 14 sorties during the day and ten sorties at night, five days a week, dropping inert 25-lb bombs and, occasionally, 500- to 1000-lb inert bombs. Per the guidelines of Ref. D-8, this is not considered a significant threat. There are two low altitude federal airways in the general area of the depot: V-4 and V-112. Three high altitude airways (J-16, J-20, and J-54) cross within 6 miles of the depot toward Pendleton, Oregon.

The installation provides limited maintenance to preclude deterioration of facilities and retains limited shipping and receiving capabilities.

D.1.9. REFERENCES

D-1. Science Applications International Corporation, "Probabilities of Selected Hazards in Disposition of M55 Rockets," U.S. Army Toxic and Hazardous Materials Agency, M55-CS-2, November 1985.

D-2. Jeppesen, "United States High Altitude Enroute Charts," U.S. (HI) 1-5, March 1986.

D-3. "Aircraft Hazards," U.S. Nuclear Regulatory Commission Standard Review Plan 3.5.1.6, NUREG-0800, Rev 2, July 1981.

APPENDIX E
(Deleted)

APPENDIX F
MUNITION FAILURE THRESHOLDS

F.1. MUNITION FAILURE THRESHOLDS

The munition stockpile is comprised of 11 different munition types. This appendix contains a description of the physical characteristics of each munition type, a description of their existing storage configurations, and a description of the munition failure thresholds that are important for quantifying the agent release associated with each accident scenario. The failure thresholds discussed herein are the thresholds for accidental burster detonation, the thermal threshold for hydraulic rupture of the agent compartment, and the mechanical failure thresholds which lead to failure of the agent compartment.

F.1.1. DESCRIPTION OF CHEMICAL MUNITIONS

The chemical stockpile is presently made up of the following munitions:

1. 8-in. artillery projectiles. The 8-in. projectiles are filled with the nerve, agent either GB or VX. They are stored without fuzes, but they may be stored with or without bursters. The 8-in. projectiles are stored on wooden pallets with six rounds per pallet.

2. 155-mm artillery projectiles. The 155-mm projectiles may contain GB, VX, or mustard. They are stored without fuzes, but they may be with or without bursters. The 155-mm projectiles are stored on wooden pallets with eight rounds per pallet.

3. 105-mm artillery rounds. The rounds are filled with either mustard or GB. The rounds may be stored as bare projectiles

on wooden pallets, with 24 rounds per pallet, and with 2 pallets butted together and secured with steel banding, or as cartridges in fiber tubes, with two tubes in a wooden field box, and with either 12 or 15 boxes unitized on a skid based wooden pallet. The cartridges include burster, fuze, cartridge case and propellant.

4. 4.2-in. mortar projectiles. All are filled with mustard agent. The mortars may be stored with burster, fuze, and propellant in fiber tubes, with two tubes in a wooden field box, with either 36 boxes on a wooden pallet, or 24 boxes on a wooden skid base. The mortars may also be stored without burster and fuze in wooden pallets.

5. M23 land mines. All land mines are filled with VX. The mines are burstered, and are packaged three to a steel drum. Mine activators and fuzes are packaged separately in the same drum. Twelve drums are contained on a wooden pallet.

6. M55 rockets. The M55 rockets are filled with either GB or VX. The rockets are equipped with fuzes and bursters which contain explosives. Propellant is also built into the motor of the rocket. The rocket casing is made of aluminum which may slowly react with nerve agent to form hydrogen gas. Pressure buildup in some of the rockets has caused a leakage problem.

   The rockets are individually packaged in fiberglass shipping tubes with metal end caps. Fifteen containers with rockets are packed on a wooden pallet.

7. MC-1 750-lb bombs filled with GB. The MC-1 bombs are stored without explosive components on wooden pallets with two bombs per pallet.

8. MK-94 500-lb bombs filled with GB. The MK-94 bombs are stored without explosive components in individual MK-410 storage and shipping containers.

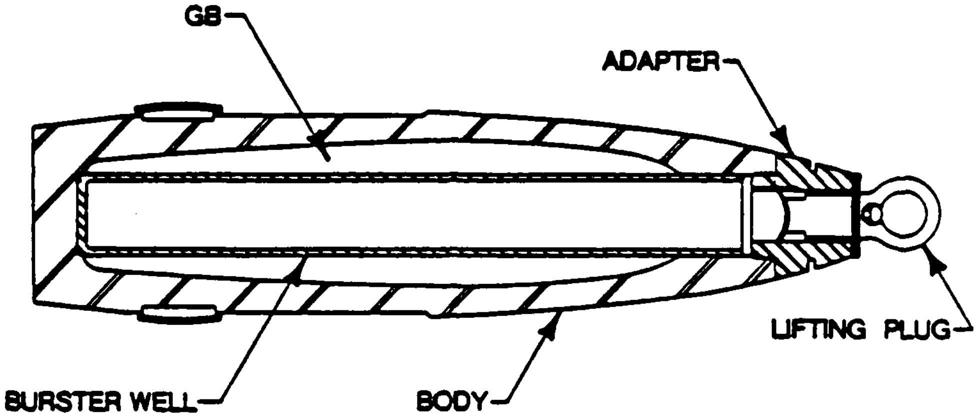
9. MK-116 (Weteye) 600-lb Navy bombs filled with GB. These bombs are stored without explosive components in individual MK-398 storage and shipping containers.

10. TMU-28/B airborne spray tanks filled with VX. They were designed for releasing chemical agent from slow-traveling, low-flying aircraft. The spray tanks are stored in individual CNU-77/E23 storage and shipping containers.

11. Ton containers. A large fraction of the chemical stockpile is stored in bulk form in cylindrical steel containers referred to as ton containers. The ton containers may contain GB, VX, or mustard. The ton containers are not palletized, but are banded together in clusters.

Drawings and photographs of each of the above munitions are shown in Figs. F-1 through F-35.

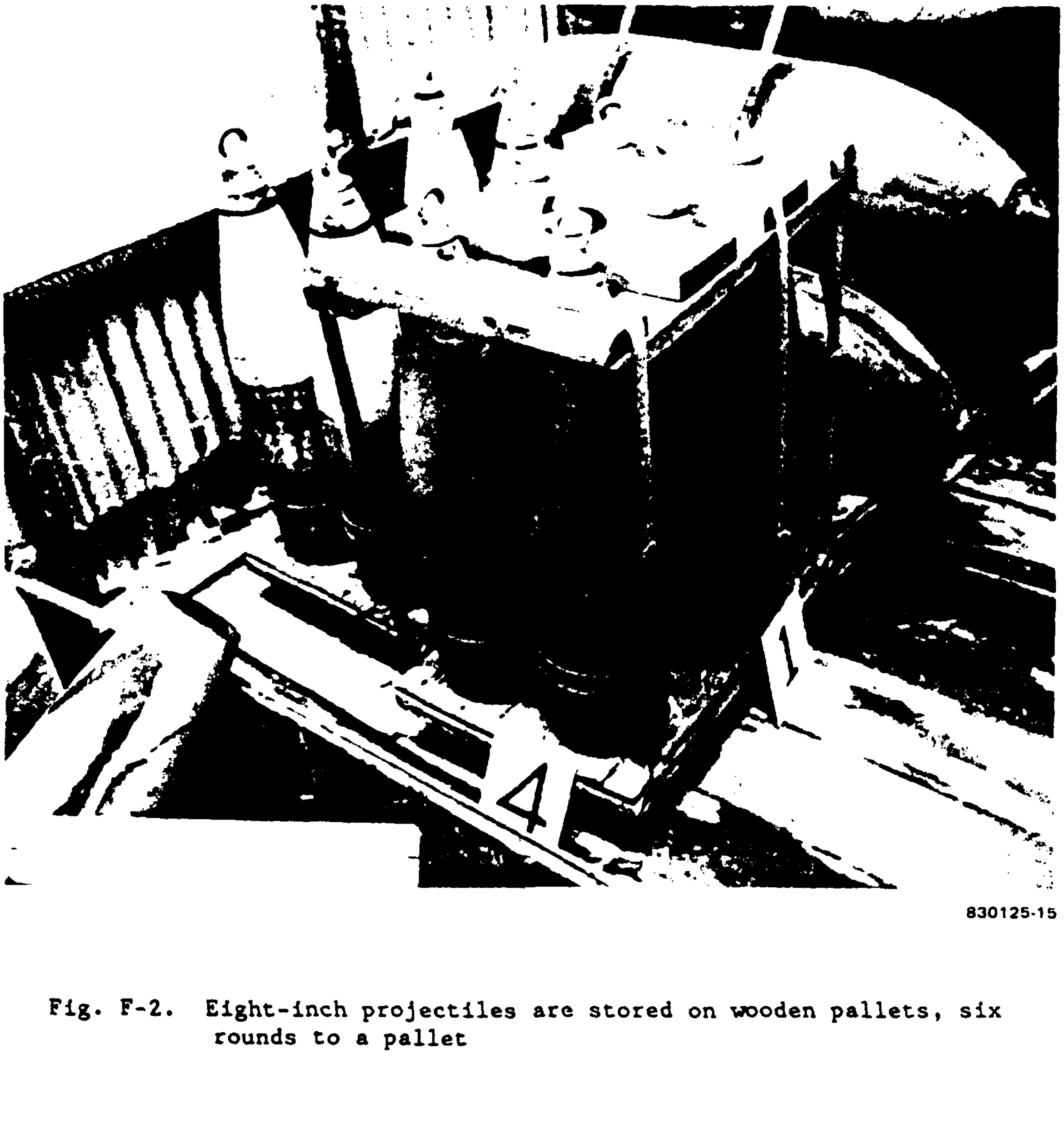
During transportation of the munitions, either to an onsite disposal facility or an offsite disposal facility, the munitions are placed in a protective shipping container or package. The shipping package has not yet been designed, but criteria for the structural and thermal protection to be provided during munition transport are defined in Ref. F-1.



LENGTH	35.1 in.
DIAMETER	8 in.
TOTAL WT.	199 lb.
AGENT	GB
AGENT WT.	14.5 lb.
FUZE	None
BURSTER	M83
EXPLOSIVE	Comp B
EXPLOSIVE WT.	7.0 lb.
SUPP. CHARGE	0.3 lb. TNT
PROPELLANT	None
PROPELLANT WT.	N/A
PRIMER	None
QD/SCG	8A
PACKAGING	6 rounds/wooden pallet

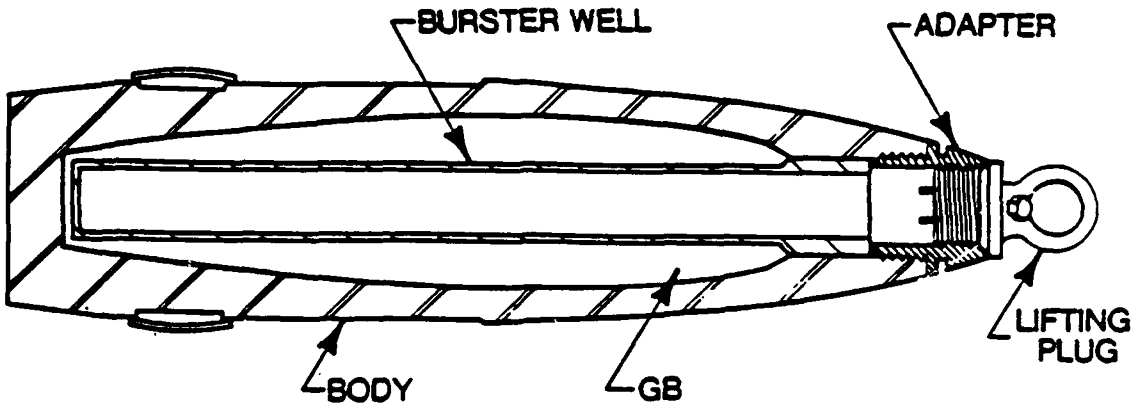
PROJECTILE, 8 INCH, GB, M426

Fig. F-1. Projectile, 8-in., GB, M426



830125-15

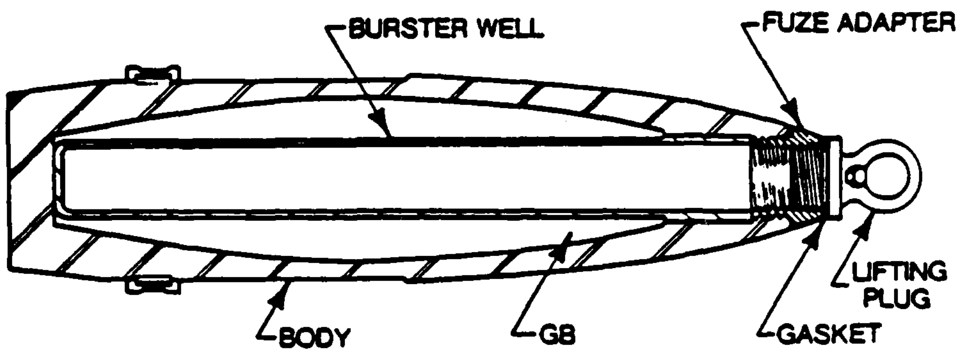
Fig. F-2. Eight-inch projectiles are stored on wooden pallets, six rounds to a pallet



LENGTH	26.7 in.
DIAMETER	155mm
TOTAL WT.	100 lb.
AGENT	GB
AGENT WT.	6.5 lb.
FUZE	None
BURSTER	M37
EXPLOSIVE	Tetrytol
EXPLOSIVE WT.	2.75 lb.
SUPP. CHARGE	0.3 lb. Tetrytol
PROPELLANT	None
PROPELLANT WT.	N/A
PRIMER	None
QD/SCG	8A
PACKAGING	8 rounds/wooden pallet

PROJECTILE, 155mm, GB, M121

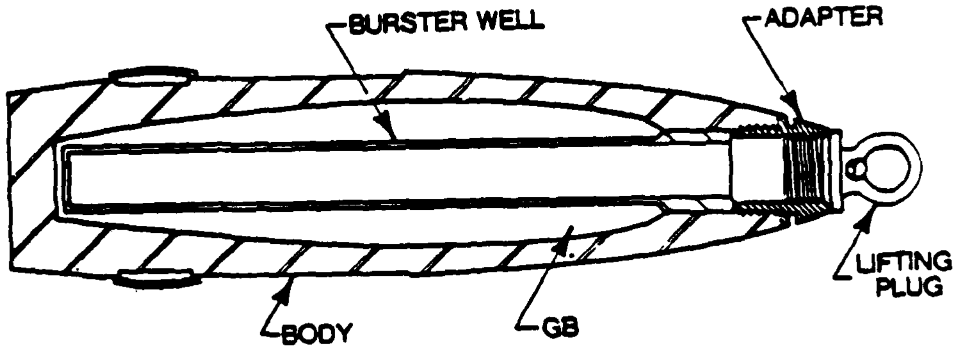
Fig. F-3. Projectile, 155-mm, GB, M121



LENGTH	26.7 in.
DIAMETER	155mm
TOTAL WT.	100 lb.
AGENT	GB
AGENT WT.	6.5 lb.
FUZE	None
BURSTER	M71
EXPLOSIVE	Comp B4
EXPLOSIVE WT.	2.45 lb.
SUPP. CHARGE	0.3 lb. Tetrytol
PROPELLANT	None
PROPELLANT WT.	N/A
PRIMER	None
QD/SCG	8A
PACKAGING	8 rounds/wooden pallet

PROJECTILE, 155mm, GB, M121A1

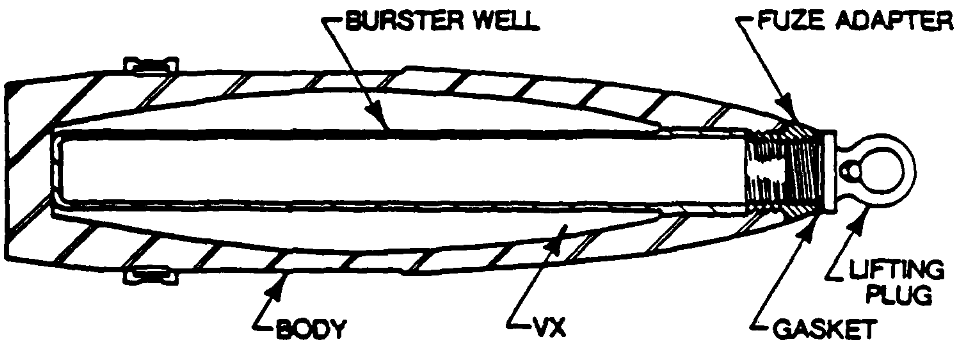
Fig. F-4. Projectile, 155-mm, GB, M121A1



LENGTH	26.7 in.
DIAMETER	155mm
TOTAL WT.	100 lb.
AGENT	GB
AGENT WT.	6.5 lb.
FUZE	None
BURSTER	M37
EXPLOSIVE	Tetrytol
EXPLOSIVE WT.	2.75 lb.
SUPP. CHARGE	0.3 lb. TNT
PROPELLANT	None
PROPELLANT WT.	N/A
PRIMER	None
QD/SCG	8A
PACKAGING	8 rounds/wooden pallet

PROJECTILE, 155mm, GB, M122

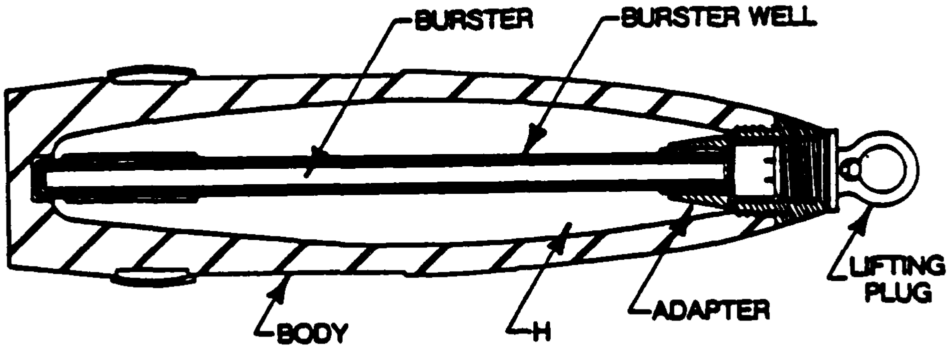
Fig. F-5. Projectile, 155-mm, GB, M122



LENGTH	26.7 in.
DIAMETER	155mm
TOTAL WT.	100 lb.
AGENT	VX
AGENT WT.	6.0 lb.
FUZE	None
BURSTER	M71
EXPLOSIVE	Comp B4
EXPLOSIVE WT.	2.45 lb.
SUPP. CHARGE	0.3 lb. Tetrytol
PROPELLANT	None
PROPELLANT WT.	N/A
PRIMER	None
QD/SCG	8A
PACKAGING	8 rounds/wooden pallet

PROJECTILE, 155mm, VX, M121A1

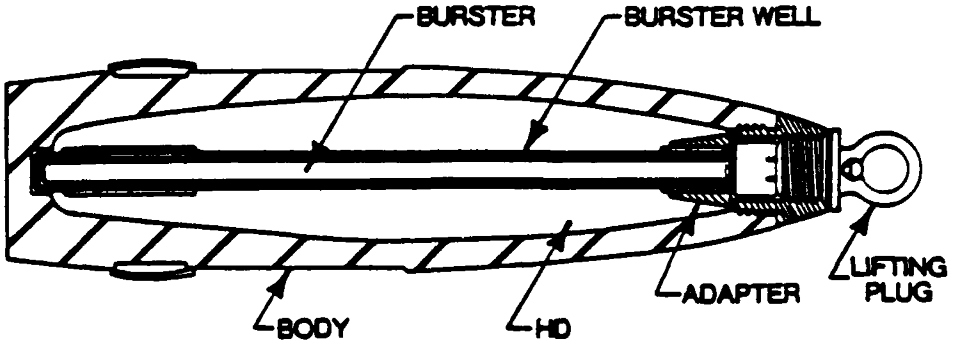
Fig. F-6. Projectile, 155-mm, VX, M121A1



LENGTH	26.8 in.
DIAMETER	155mm
TOTAL WT.	99 lb.
AGENT	H
AGENT WT.	11.7 lb.
FUZE	None
BURSTER	M6
EXPLOSIVE	Tetrytol
EXPLOSIVE WT.	.41 lb.
PROPELLANT	None
PROPELLANT WT.	N/A
PRIMER	None
QD/SCG	5A
PACKAGING	6 rounds/wooden pallet

PROJECTILE, 155mm, H, M110

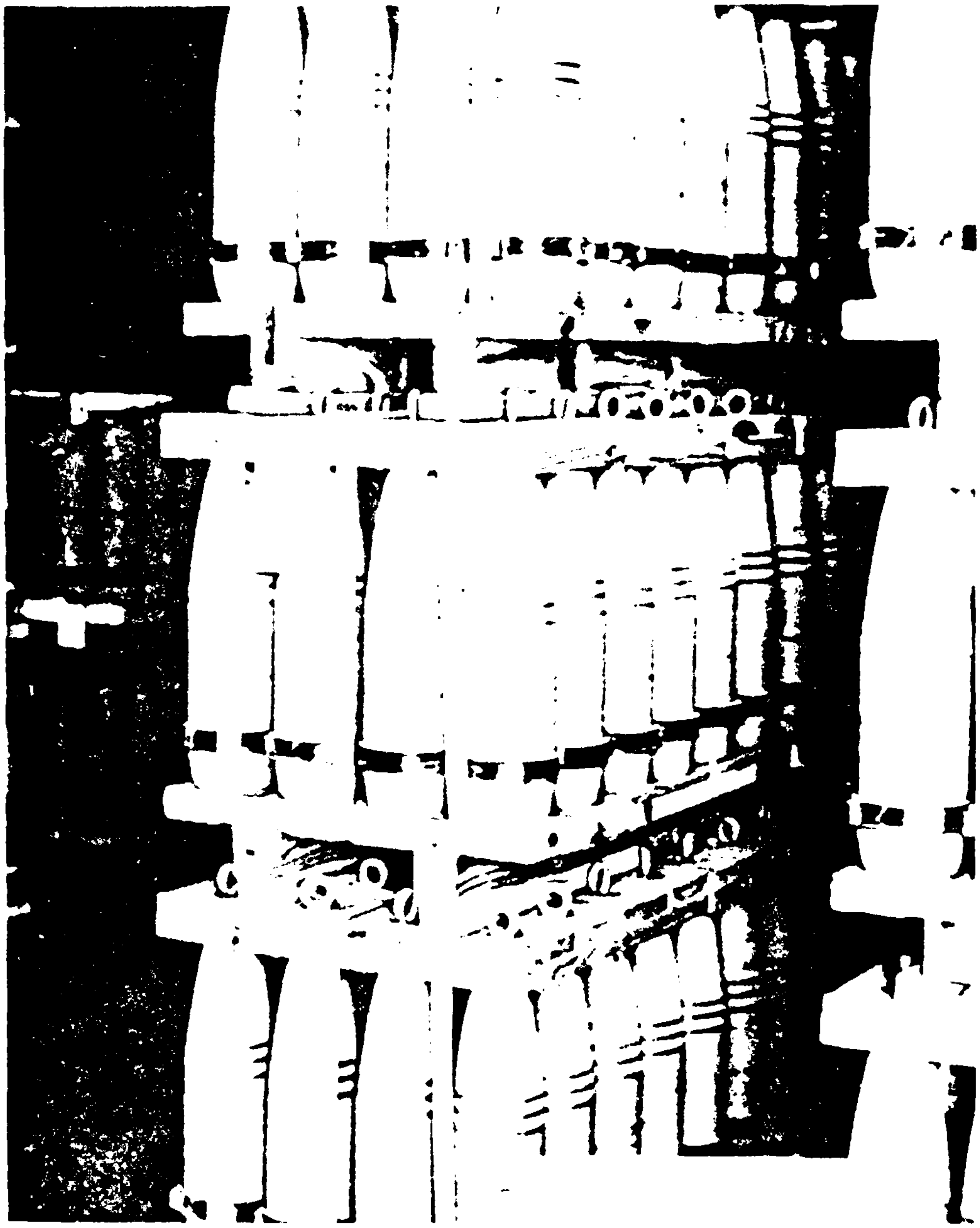
Fig. F-7. Projectile, 155-mm, H, M110



LENGTH	26.8 in.
DIAMETER	155mm
TOTAL WT.	95 lb.
AGENT	HD
AGENT WT.	11.7 lb.
FUZE	None
BURSTER	M6
EXPLOSIVE	Tetrytol
EXPLOSIVE WT.	.41 lb.
PROPELLANT	None
PROPELLANT WT.	N/A
PRIMER	None
QD/SCG	5A
PACKAGING	6 rounds/wooden pallet

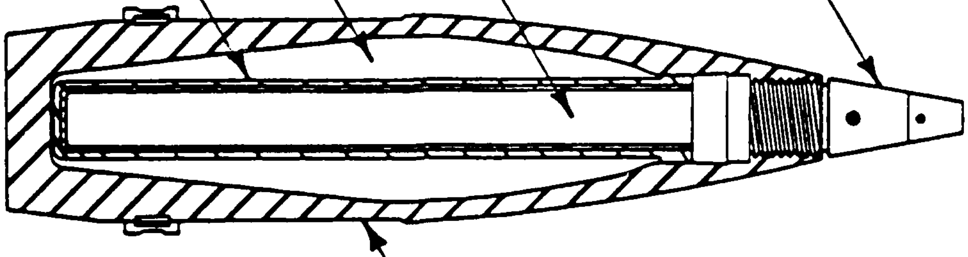
PROJECTILE, 155mm, HD, M104

Fig. F-8. Projectile, 155-mm, HD, M104



840096-2C

Fig. F-9. 155-mm projectiles are stored on wooden pallets with eight rounds per pallet

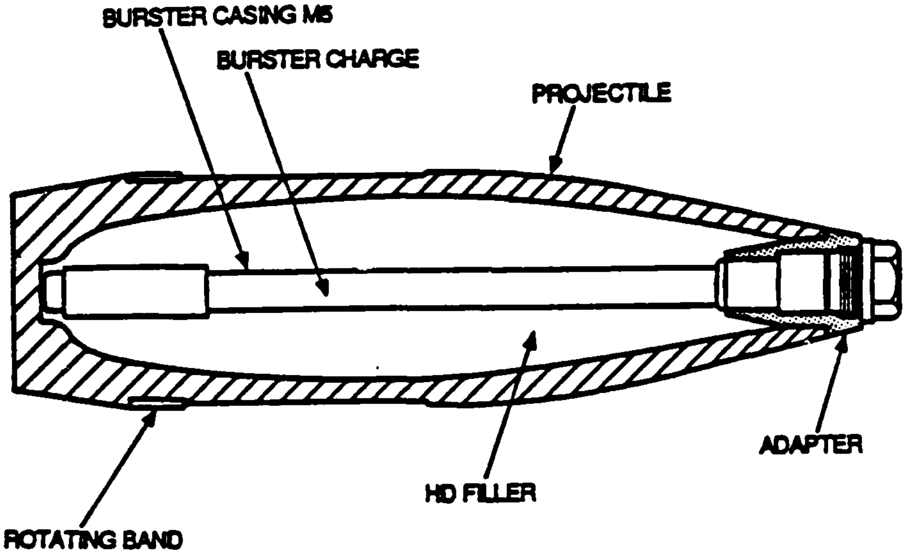


LENGTH	16.0 in.
DIAMETER	105mm
TOTAL WT.	32 lb.
AGENT	GB
AGENT WT.	1.63 lb.
FUZE	M508
BURSTER	M40, M40A1
EXPLOSIVE	Tetrytol(M-40) Comp B(M40A)
EXPLOSIVE WT.	1.12 lb.
PROPELLANT	Removed
QD/SCG	5A
PACKAGING	24 projectiles/wooden pallet

Note: Projectile is stored with and without fuze and burster. Fuze cavity of unfuzed unburstered projectile is sealed by a closing plug.

PROJECTILE, 105mm, GB, M360

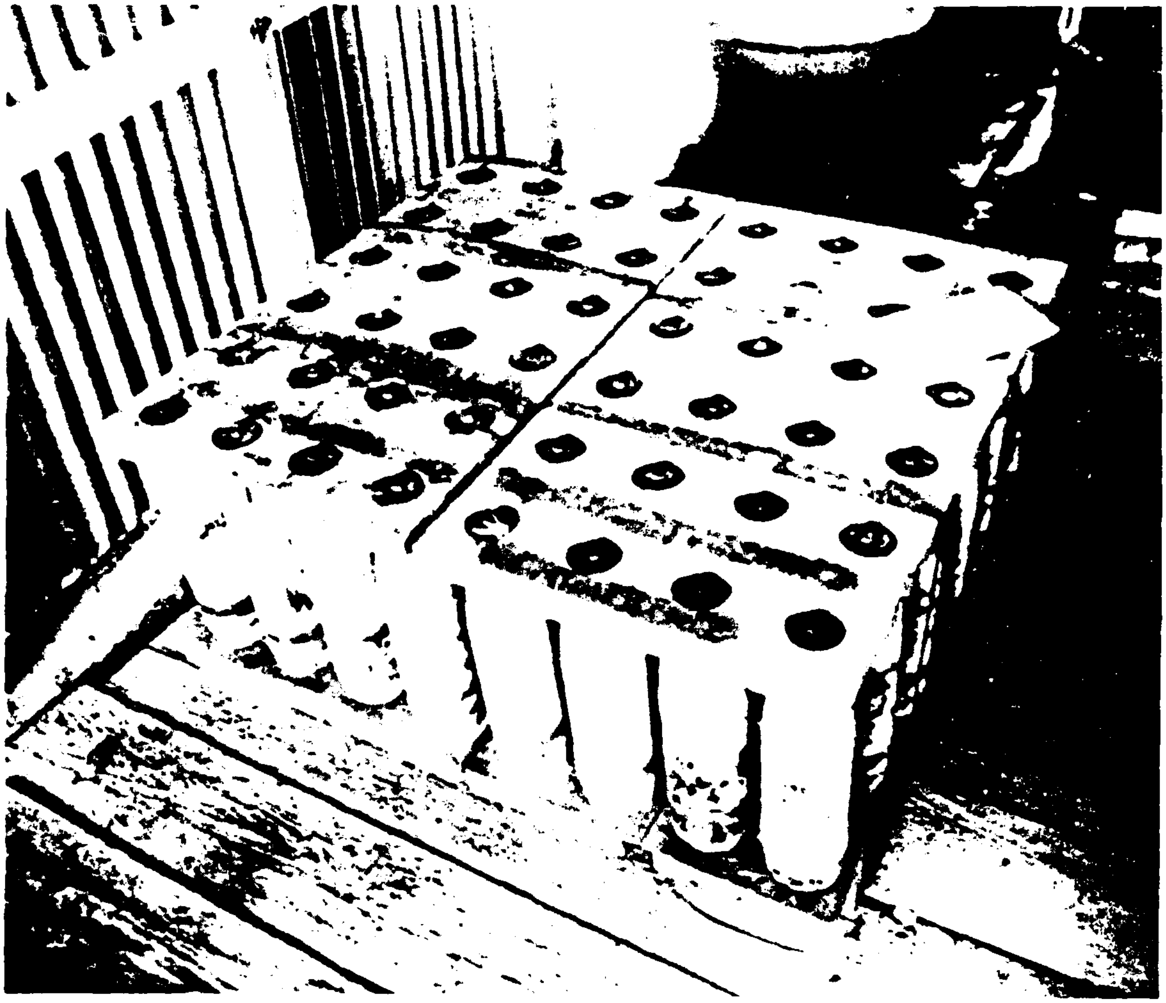
Fig. F-10. Projectile, 105-mm, GB, M360



LENGTH	21.0 in.
DIAMETER	105mm
TOTAL WT.	32 lb.
AGENT	HD
AGENT WT.	3 lb.
FUZE	PD M51A5, M57
BURSTER	M5
EXPLOSIVE	Tetrytol
EXPLOSIVE WT.	0.51 lb.
PROPELLANT	Removed
PACKAGING	24 projectiles/wooden pallet

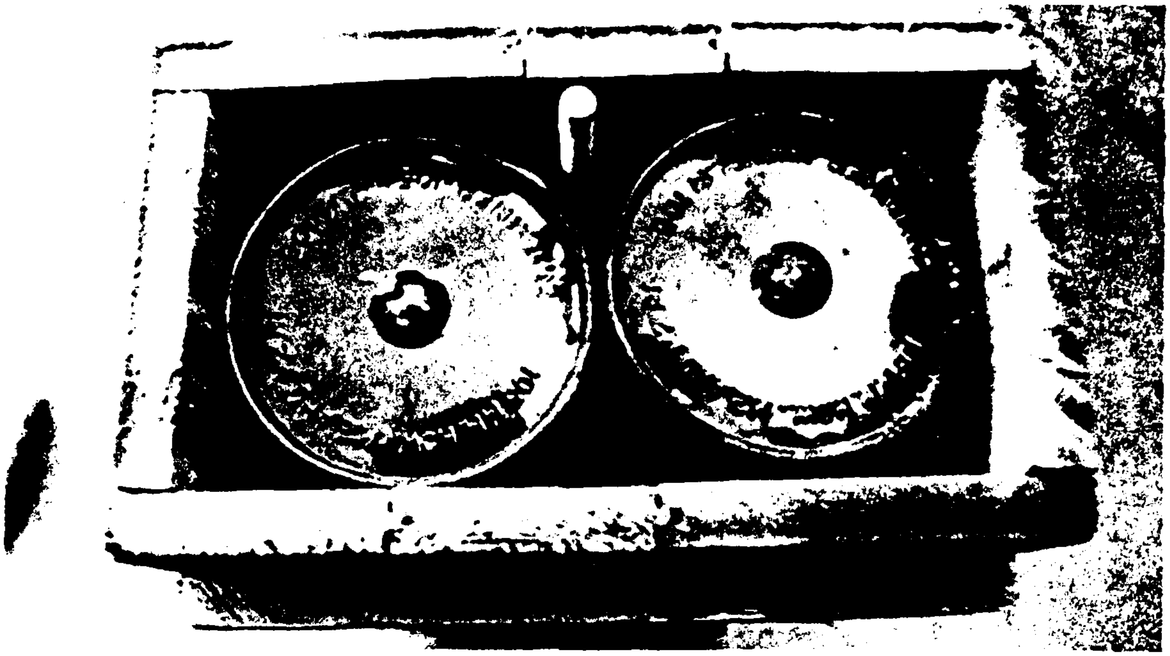
PROJECTILE, 105mm, HD, M60

Fig. F-11. Projectile, 105-mm, HD, M60

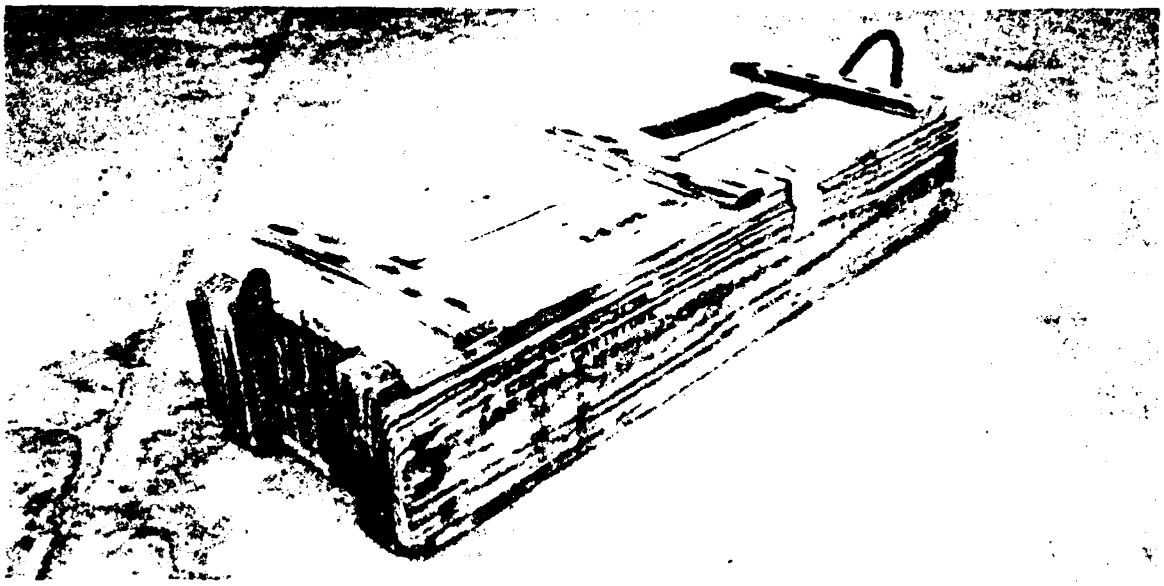


830125-21

Fig. F-12. 105-mm artillery rounds stored in one of the two acceptable configurations



840163-24

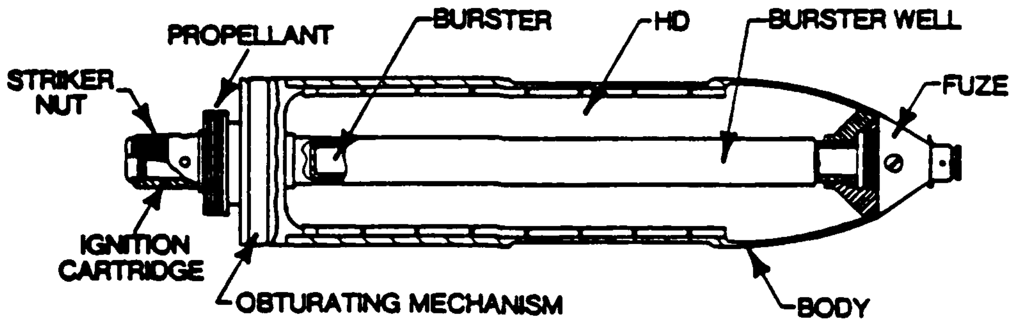


840163-15

Fig. F-13. 105-mm artillery rounds stored in cartridges in fiber tubes with two tubes to a wooden box

840099-43

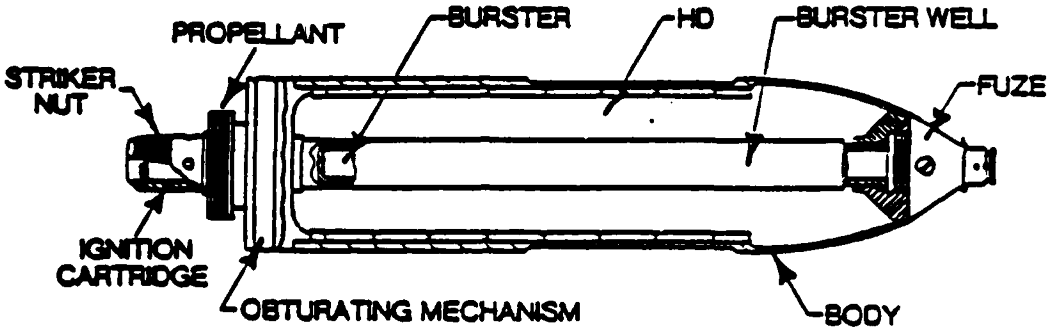
Fig. F-14. MC-1 bombs are stored on wooden pallets



LENGTH	21.0 in.
DIAMETER	4.2 in.
TOTAL WT.	25 lb.
AGENT	HD
AGENT WT.	6.0
FUZE	M8
BURSTER	M14
EXPLOSIVE	Tetryl
EXPLOSIVE WT.	.14 lb.
PROPELLANT	Removed
PRIMER	M28A2
QD/SCG	5A
PACKAGING	24 rounds/wooden pallet

CARTRIDGE, MORTAR, 4.2 INCH, HD, M2/M2A1

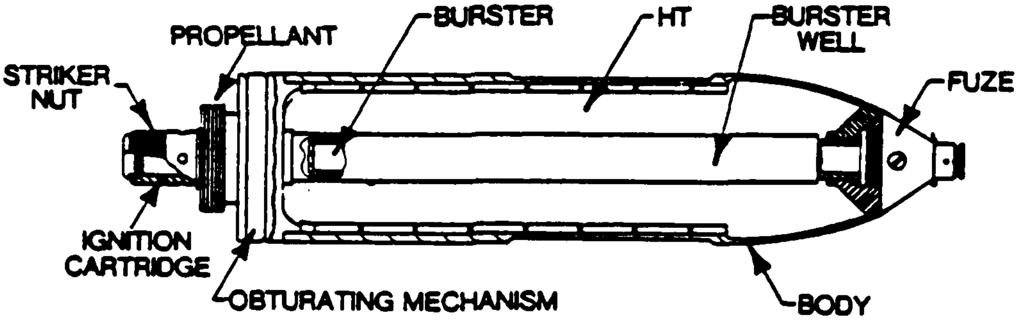
Fig. F-15. Cartridge, mortar, 4.2-in., HD, M2/M2A1



LENGTH	21.0 in.
DIAMETER	4.2 in.
TOTAL WT.	25 lb.
AGENT	HD
AGENT WT.	6.0
FUZE	M8
BURSTER	M14
EXPLOSIVE	Tetryl
EXPLOSIVE WT.	.14 lb.
PROPELLANT	Removed
PRIMER	M28A2
QD/SCG	5A
PACKAGING	24 rounds/wooden pallet

CARTRIDGE, MORTAR, 4.2 INCH, HD, M2/M2A1

Fig. F-16. Cartridge, mortar, 4.2-in., HD, M2/M2A1



LENGTH	21.0 in.
DIAMETER	4.2 in.
TOTAL WT.	25 lb.
AGENT	HT
AGENT WT.	5.8 lb.
FUZE	M51A5
BURSTER	M14
EXPLOSIVE	Tetryl
EXPLOSIVE WT.	.14 lb.
PROPELLANT	Removed
PRIMER	M28A2
QD/SCG	5A
PACKAGING	24 rounds/wooden pallet

CARTRIDGE, MORTAR, 4.2 INCH, HT, M2/M2A1

Fig. F-17. Cartridge, mortar, 4.2-in., HT, M2/M2A1

830125-7

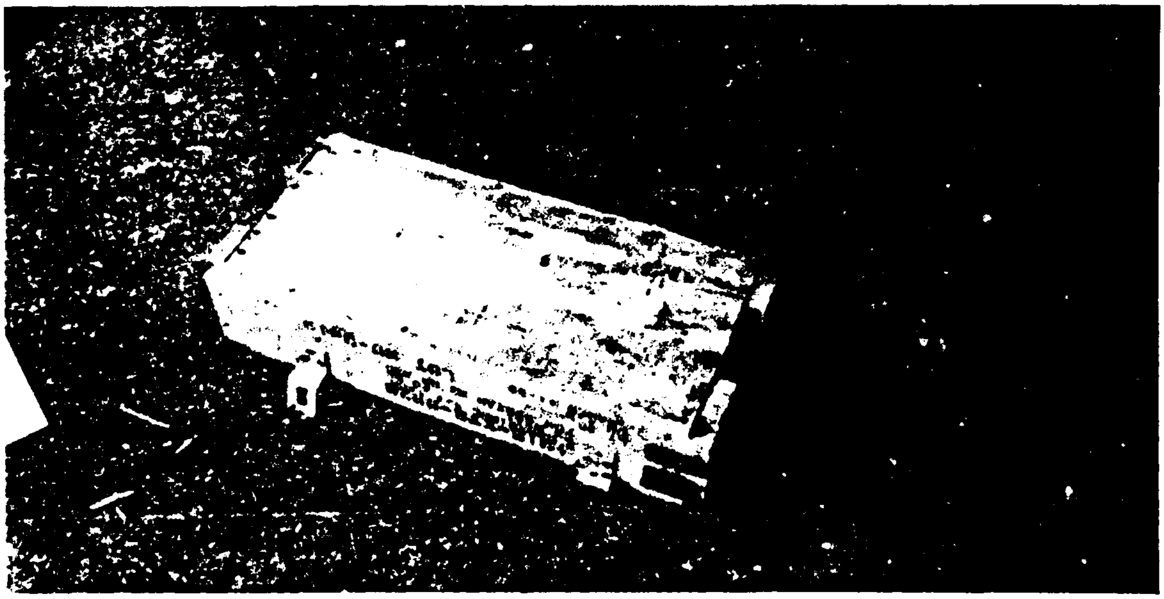


Fig. F-18. 4.2-in. mortars are stored in fiber tubes with two tubes per wooden box

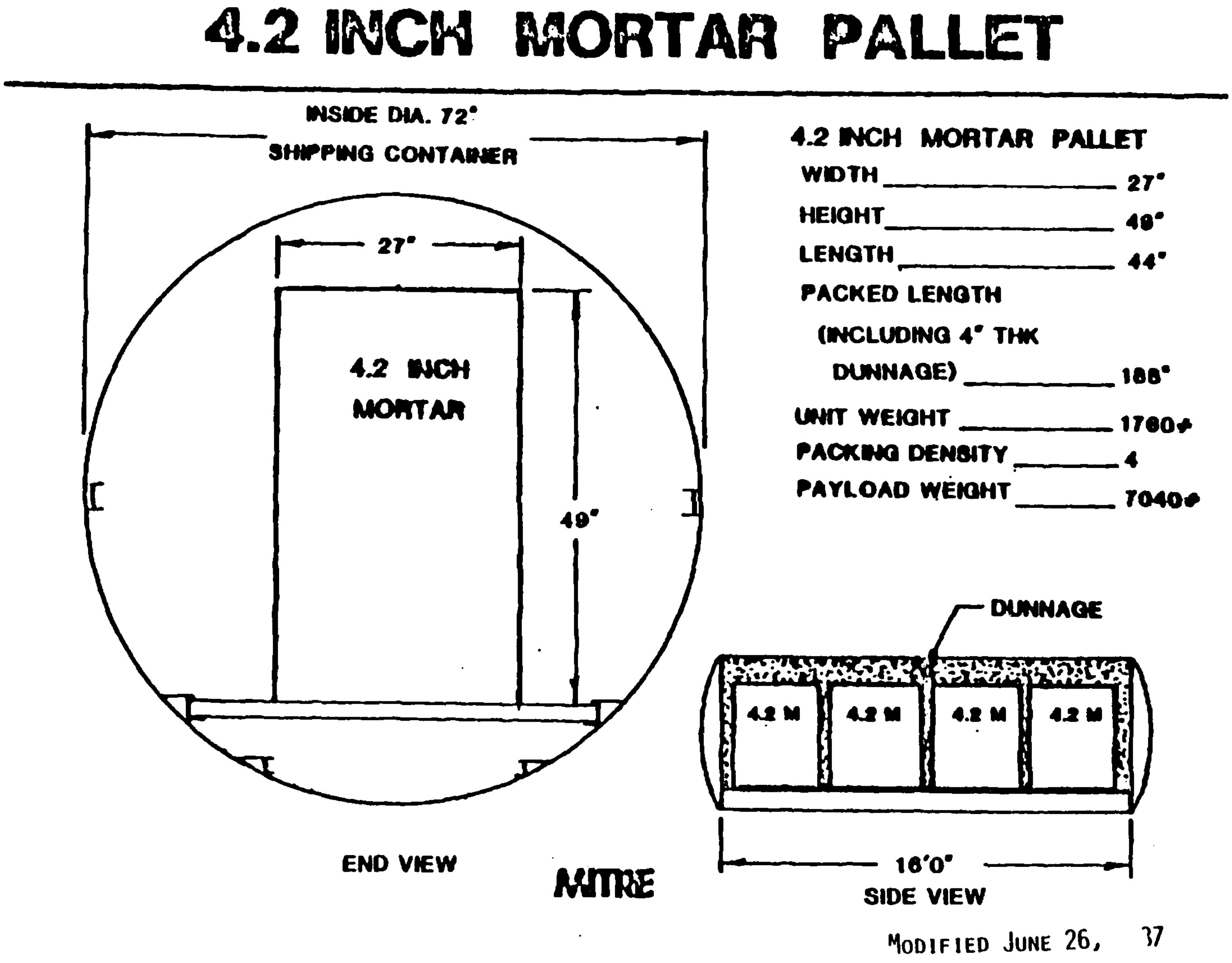
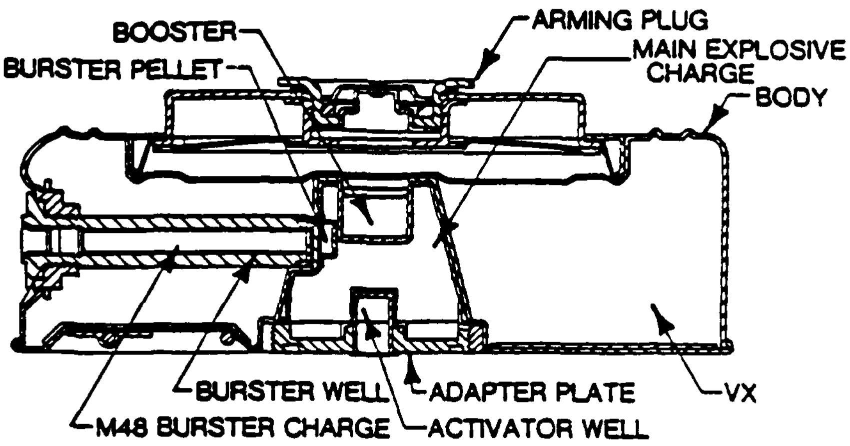


Fig. F-19. 4.2-in. mortar round pallet containing 48 rounds packed two per box



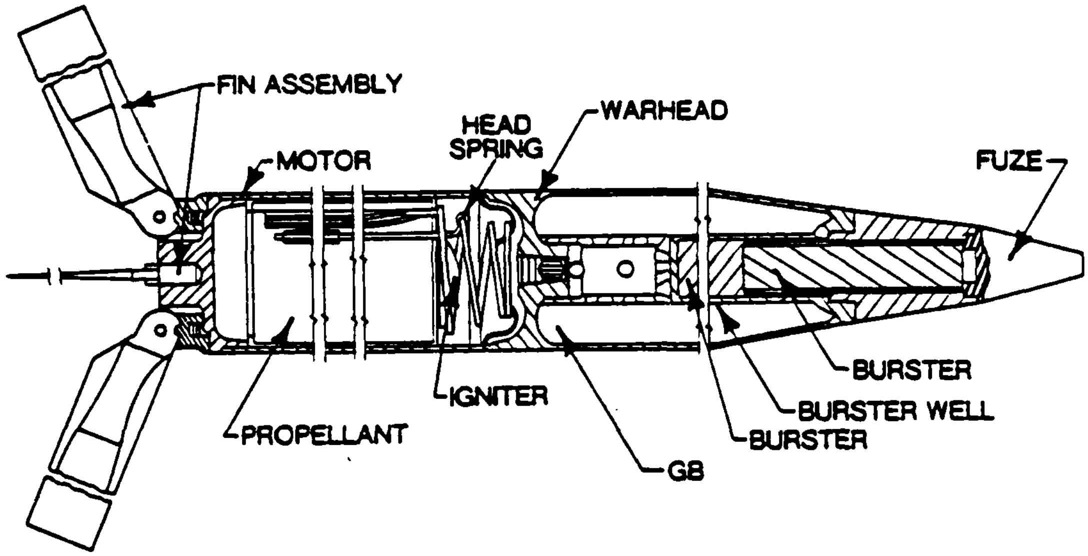
HEIGHT	5 in.
DIAMETER	13.5 in.
TOTAL WT.	23 lb.
AGENT	VX
AGENT WT.	10.5 lb.
FUZE	M603
BURSTER	M38
EXPLOSIVE	Comp B
EXPLOSIVE WT.	.8 lb.
PROPELLANT	None
PROPELLANT WT.	N/A
PRIMER	N/A
QD/SCG	5A
PACKAGING	3 mines/steel drum

MINE, 2 GALLON, VX, M23

Fig. F-20. Mine, 2-gal, VX, M23


830125-3

Fig. F-21. M23 mines are stored in drums with three mines per drum

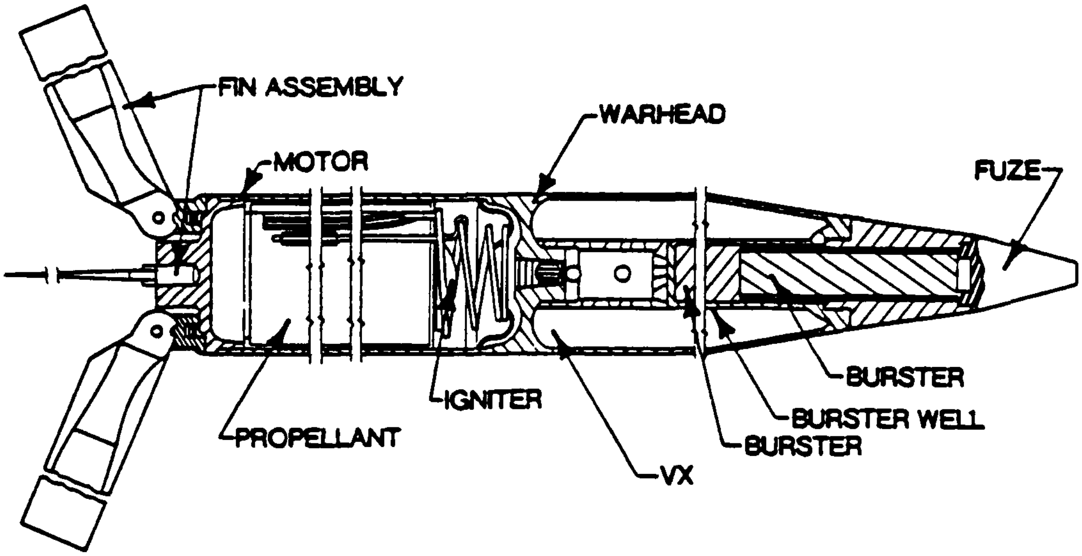


LENGTH	78.0 in.
DIAMETER	115mm
TOTAL WT.	57 lb.
AGENT	GB
AGENT WT.	10.7 lb.
FUZE	M417
BURSTER	M34, M36
EXPLOSIVE	Comp B
EXPLOSIVE WT.	3.2 lb.
PROPELLANT	M28
PROPELLANT WT.	19.3
PRIMER	M62
QD/SCG	5A
PACKAGING	15 rounds/wooden pallet

Note: Stored in firing tube with fins folded toward the axis.

ROCKET, 115mm, GB, M55

Fig. F-22. Rocket, 115-mm, GB, M55

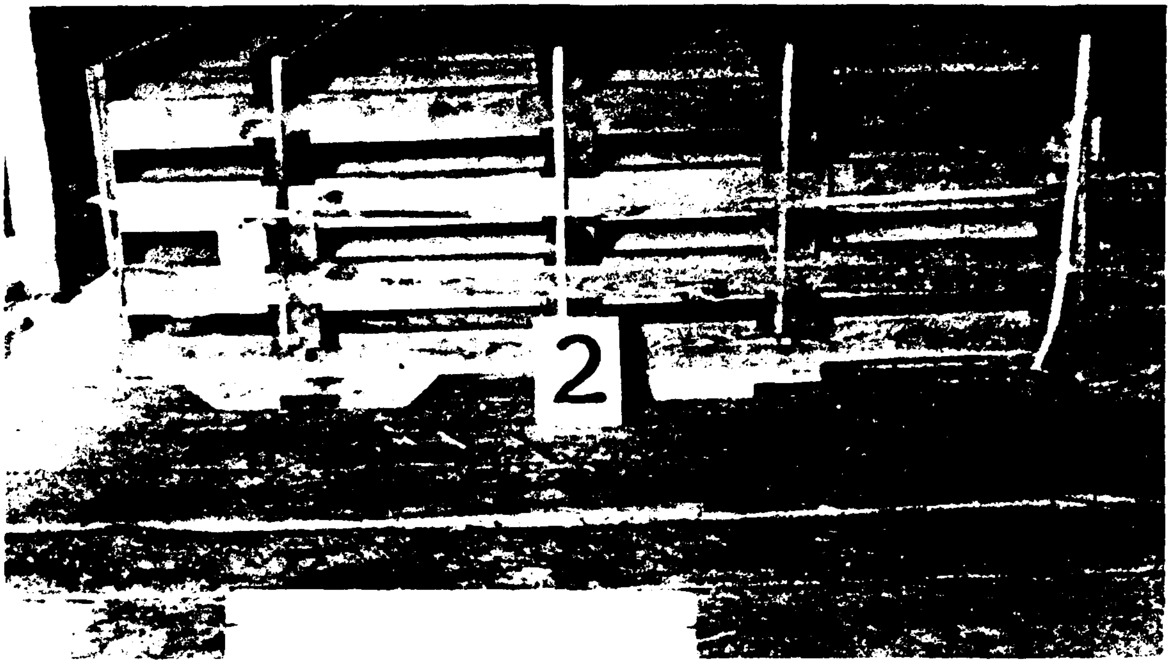


LENGTH	78 in.
DIAMETER	115mm
TOTAL WT.	56 lb.
AGENT	VX
AGENT WT.	10.0 lb.
FUZE	M417
BURSTER	M34, M36
EXPLOSIVE	Comp B
EXPLOSIVE WT.	3.2 lb.
PROPELLANT	M67
PROPELLANT WT.	19.3 lb.
PRIMER	M62
QD/SCG	5A
PACKAGING	15 round/wooden pallet

Note: Stored in firing tube with fins folded toward the axis.

ROCKET, 115mm, VX, M55

Fig. F-23. Rocket, 115-mm, VX, M55



830125-12

Fig. F-24. M55 rockets are stored in their shipping tubes with 15 rockets housed in a wooden crate

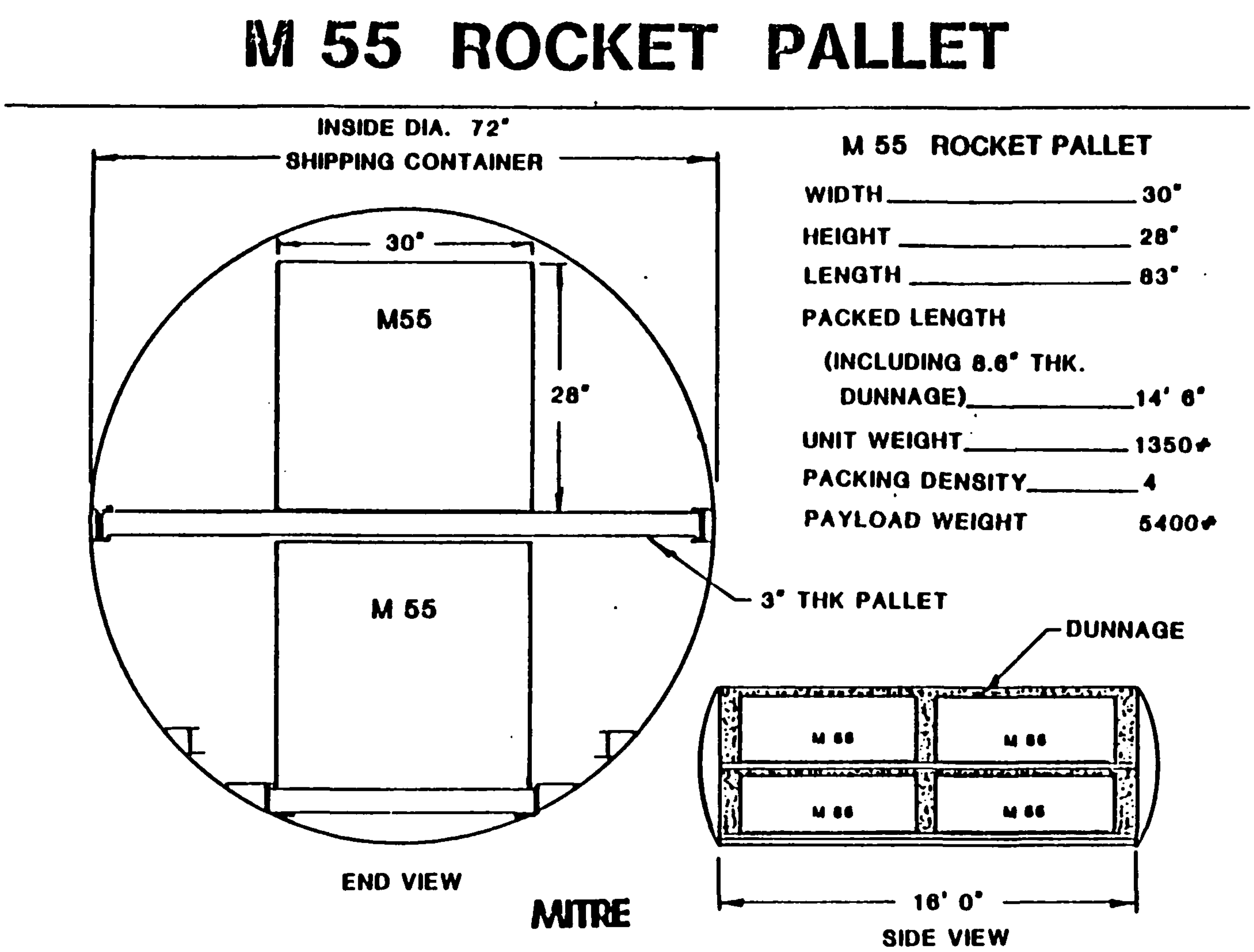
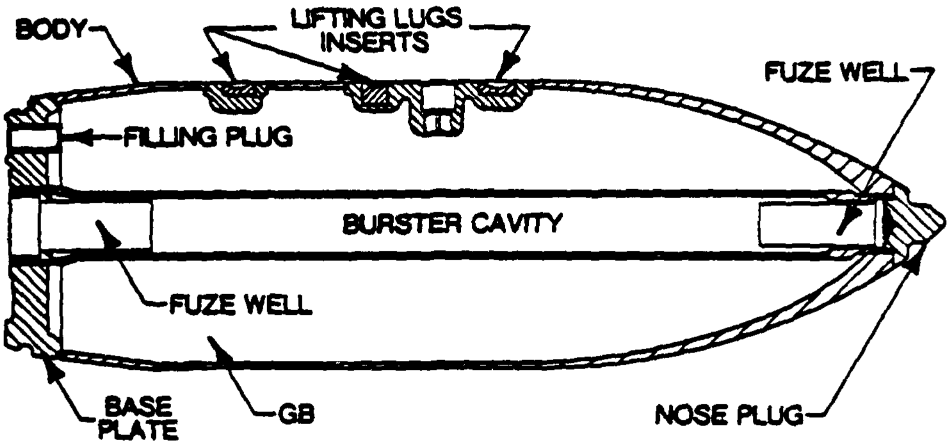


Fig. F-25. 115-mm M55 rocket pallet containing 15 rockets in individual fiberglass tubes (15/pallet)



LENGTH	50 in.
DIAMETER	16 in.
TOTAL WT.	725 lb.
AGENT	GB
AGENT WT.	220 lb.
FUZE	None
BURSTER	None
EXPLOSIVE	None
EXPLOSIVE WT.	N/A
PROPELLANT	None
PROPELLANT WT.	N/A
PRIMER	None
QD/SCG	8A
PACKAGING	2 bombs/wooden pallet

BOMB, 750 LB., GB, MC-1

Fig. F-26. Bomb, 750-lb, GB, MC-1

MC-1 BOMB PALLET

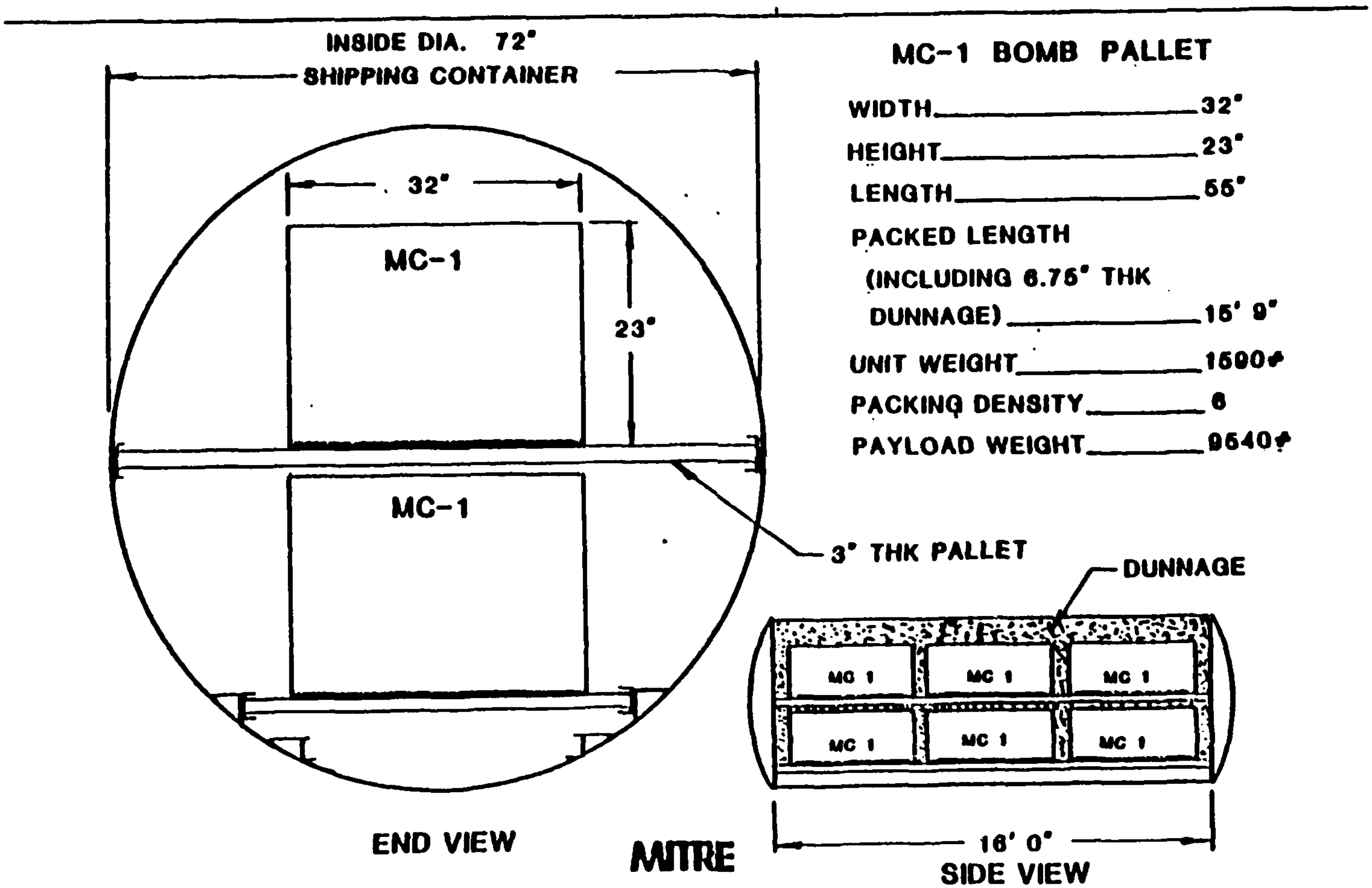
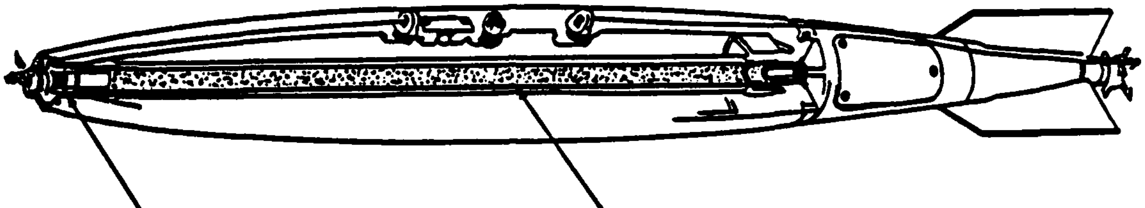


Fig. F-27. MC-1 750-lb bomb pallet with two bombs



LENGTH	89 in.
DIAMETER	11 in.
TOTAL WT.	441 lb.
AGENT	GB
AGENT WT.	108
FUZE	None
BURSTER	None
EXPLOSIVE	None
EXPLOSIVE WT.	N/A
PROPELLANT	None
PRIMER	None
PACKAGING	1 bomb/pallet

Fig. F-28. Bomb, 500-lb, GB, MK 94-0

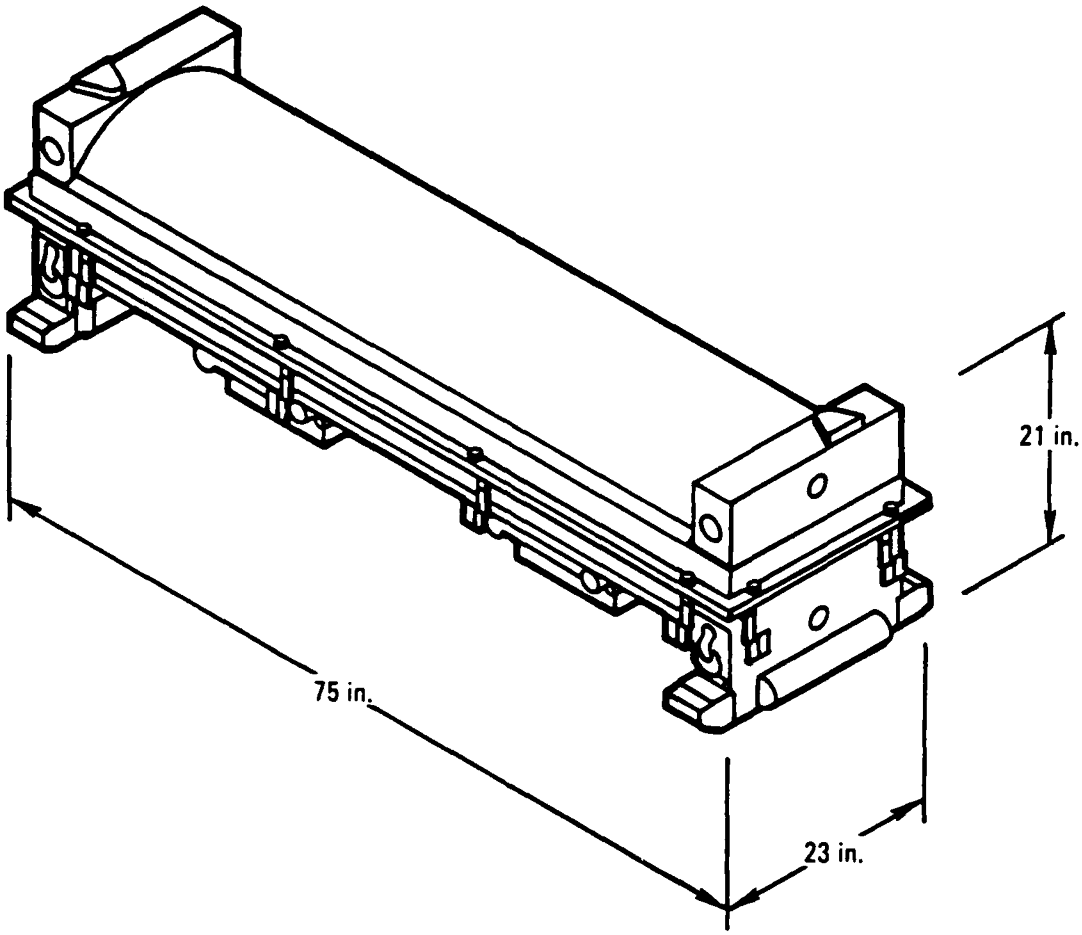
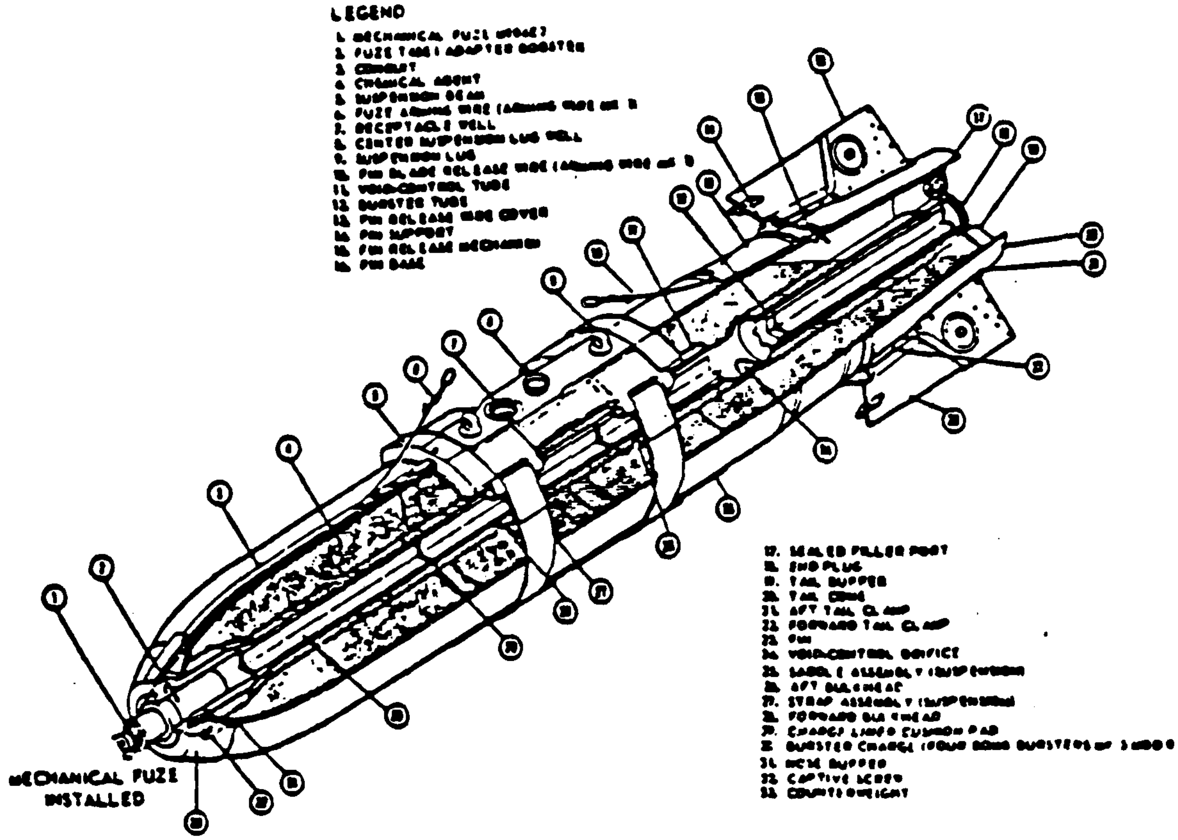
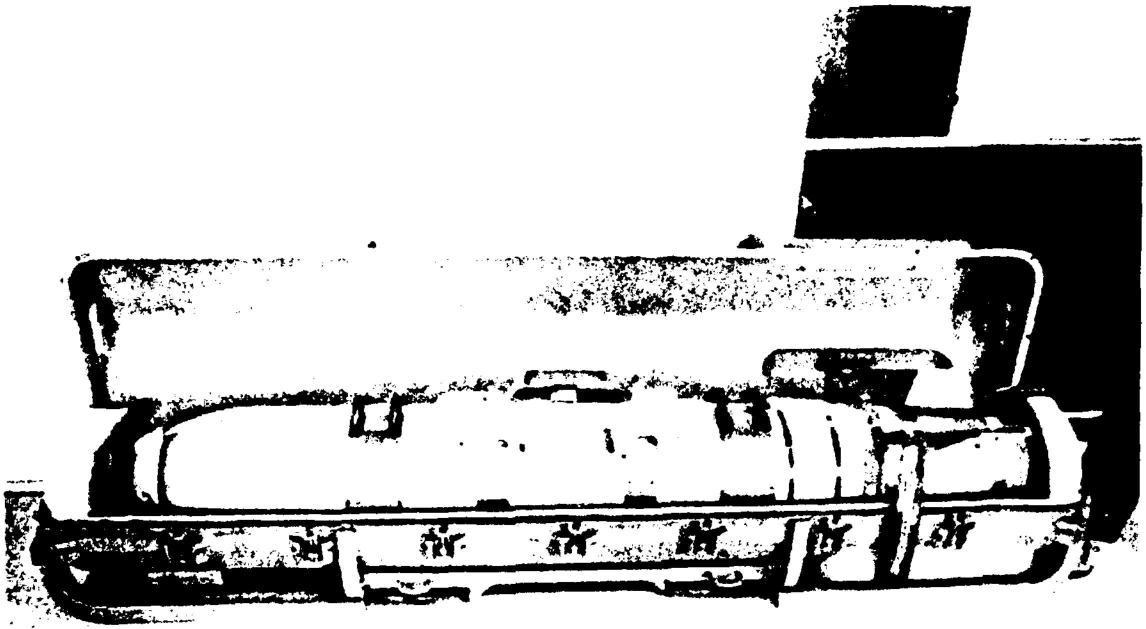


Fig. F-29. MK-94 bombs are stored individually in MK-410 storage and shipping containers



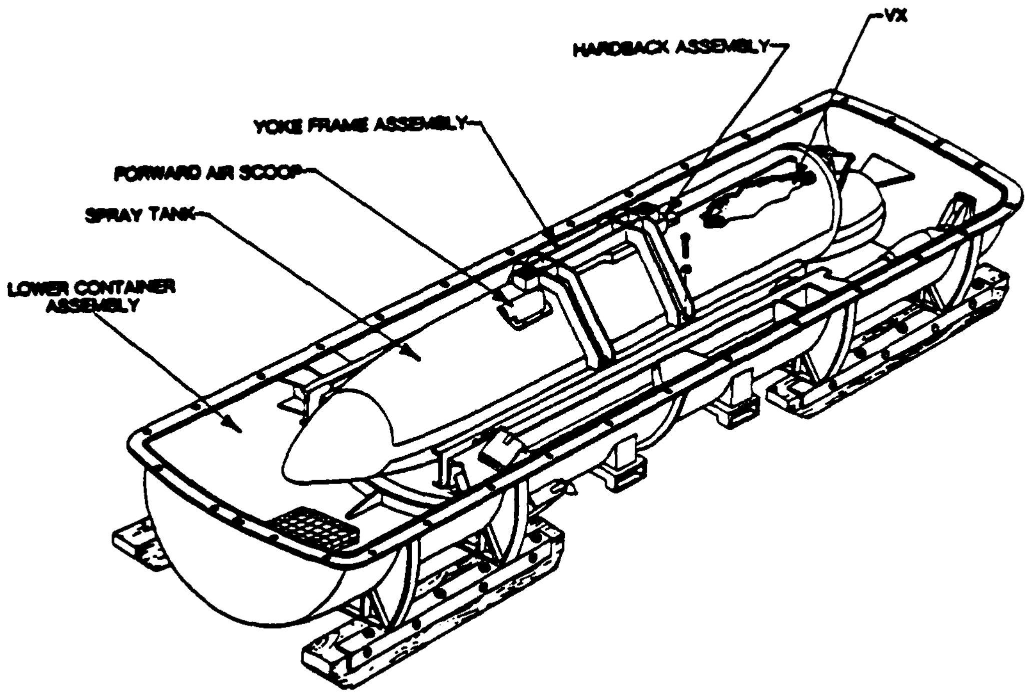
LENGTH	86 in.
DIAMETER	14 in.
TOTAL WT.	525 lb.
AGENT	GB
AGENT WT.	384 lb.
FUZE	M904E2
BURSTER	None
EXPLOSIVE	None
EXPLOSIVE WT.	N/A
PROPELLANT	None
PRIMER	None
PACKAGING	Stored in a metal shipping and storage container

Fig. F-30. MK-116 Mod O bomb (Weteye) with M990 D fuze installed



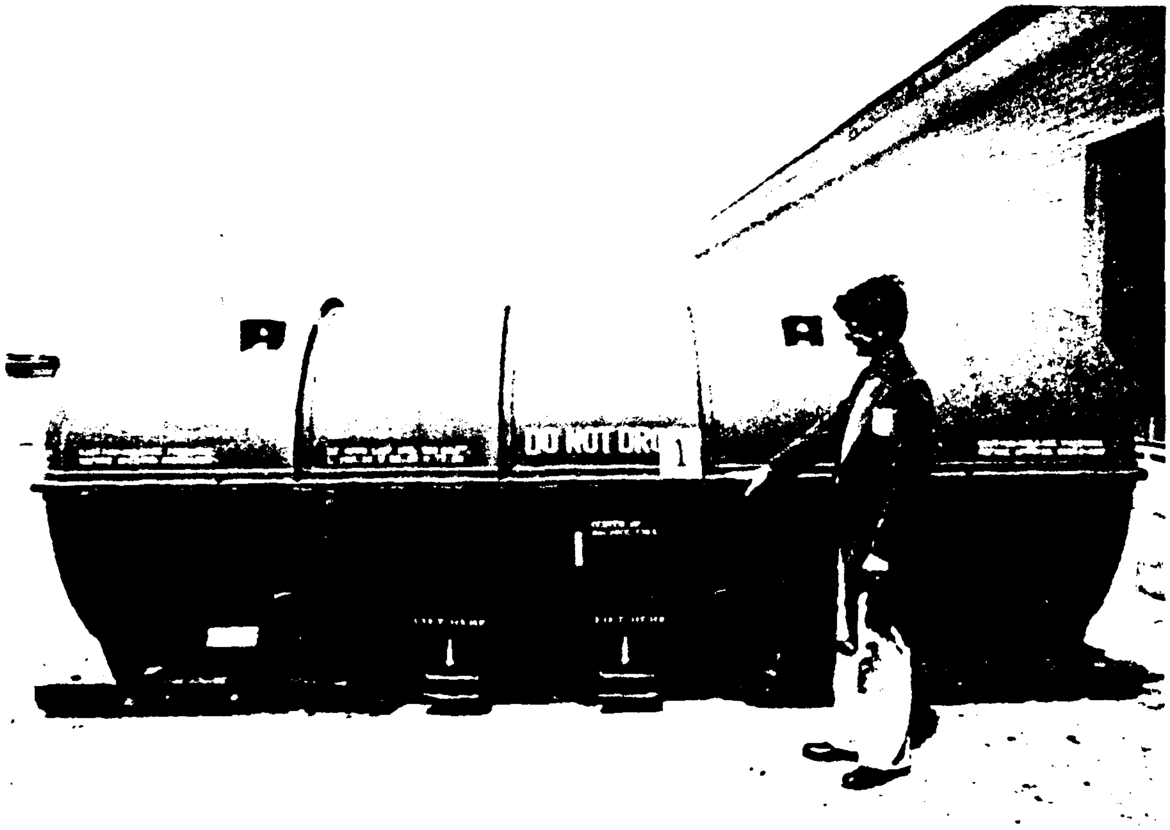
840099-158

Fig. F-31. MK-116 bombs are stored individually in MK-398 storage containers



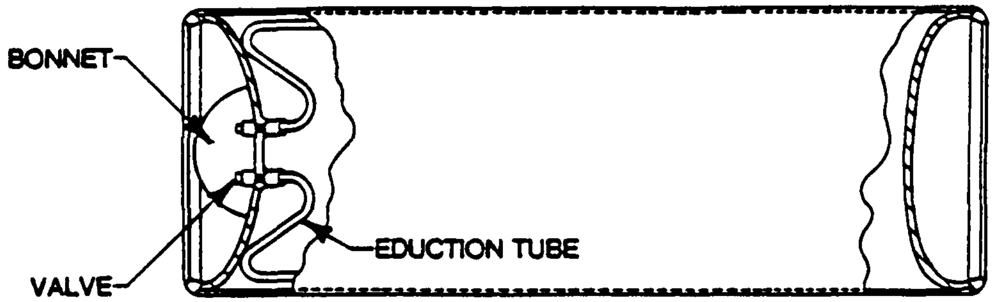
LENGTH	185 in.
DIAMETER	22.5 in.
TOTAL WT.	1935 lb.
AGENT	VX
AGENT WT.	1356 lb.
FUZE	None
BURSTER	None
EXPLOSIVE	None
EXPLOSIVE WT.	N/A
PROPELLANT	None
PROPELLANT WT.	N/A
PRIMER	None
QD/SCG	8A
PACKAGING	1 tank/steel container

Fig. F-32. Tank, spray, VX, TMU-28/B



840099-87

Fig. F-33. Spray tanks are stored individually in CNU-77/E23 storage and shipping containers



LENGTH	81.5 in.		
DIAMETER	30.1 in.		
TOTAL WT.	3100 lb.;	2900 lb.;	3000 lb.
AGENT	HD	GB	VX
AGENT WT.	1700	1500	1600
FUZE	None		
BURSTER	None		
EXPLOSIVE	None		
EXPLOSIVE WT.	N/A		
PROPELLANT	None		
PROPELLANT WT.	N/A		
PRIMER	None		
QD/SCG	8A		
PACKAGING	None		

TON CONTAINER

Fig. F-34. Ton container

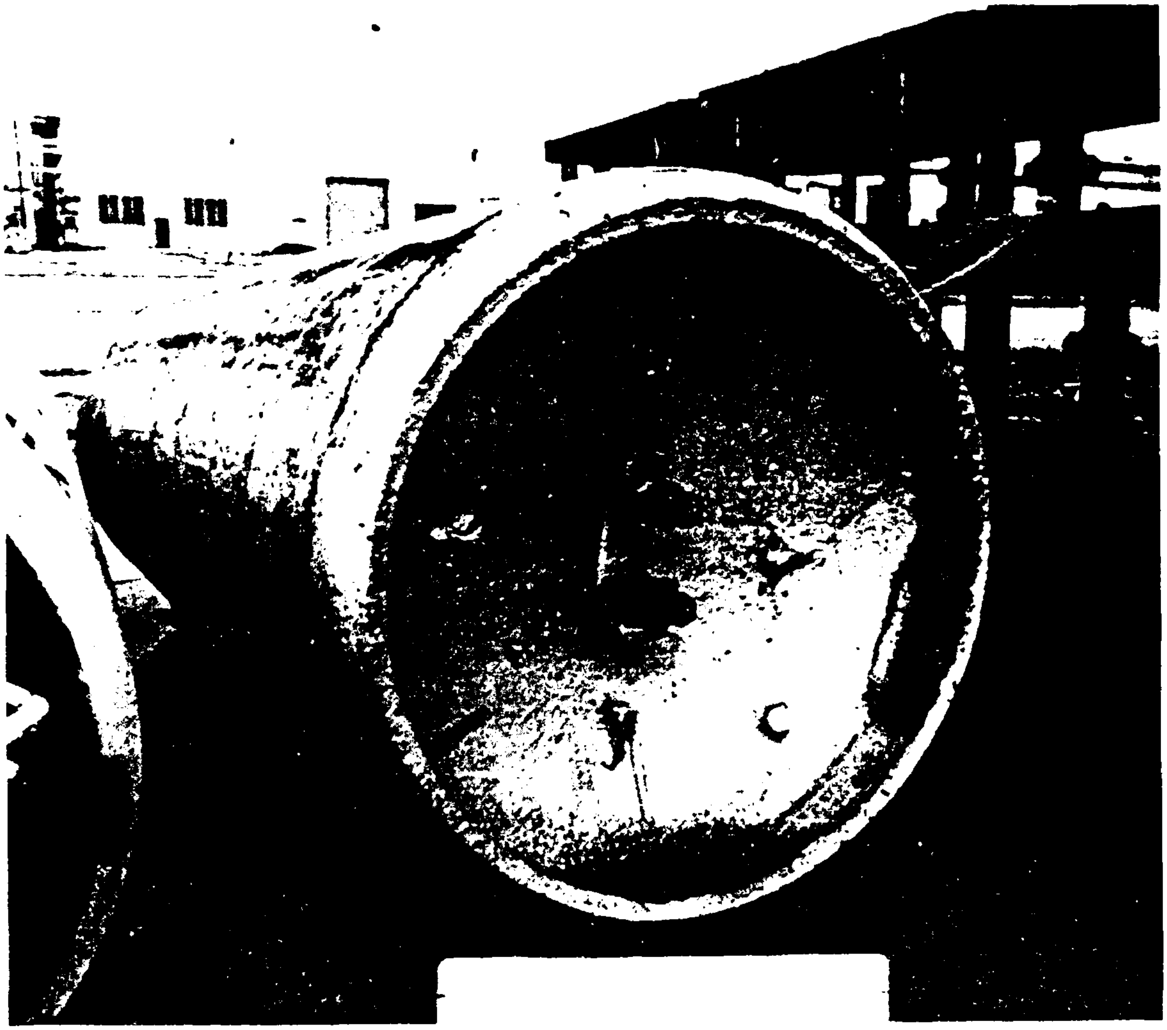


Fig. F-35. Ton containers store chemical agents in bulk form

F.1.2. BURSTER DETONATION THRESHOLD

Stimuli which can initiate detonations in high explosives include (Ref. F-2):

- Shock initiation.
- Impact initiation.
- Thermal initiation.
- Friction.
- Static electric discharge.

High explosives can always be detonated by sufficiently strong shock waves because that is their mode of initiation in normal use. By design, burster reaction initiated by either friction or static electric discharge is considered incredible. In addition, secondary high explosives are relatively insensitive to shock and impact initiation for safety in use, transportation, and storage. Nevertheless, accidental detonation of munitions is considered credible when the munitions are subjected to undue force arising from an accident. A measure of the sensitivity of the munitions to accidental impact is indicated by the Susan test. In this test, the ignition point of the high explosive is determined as a function of impact velocity. Given the explosive confinement designed into the munition, ignition can be interpreted as leading to a violent explosion. According to Ref. F-3, the threshold velocity for ignition is about 180 ft/s (123 mph) for COMP B-3 and 235 ft/s (160 mph) for TNT. COMP B-3 and TNT are major components of the munition bursters. These velocities are well above any credible impact velocity arising from the accident scenarios considered herein except the aircraft crash. However, spontaneous, or unexplained detonations have been known to occur. Therefore, the possibility of a detonation is evaluated for those accidents which may introduce an undue force as part of the accident scenario.

F.1.3. THERMAL FAILURE THRESHOLDS

The thermal failure threshold is defined as the time to fail the agent compartment when the munition is enveloped by fire. In the case of burstered munitions, including those which are also packaged with propellant, the thermal threshold may be a violent detonation. For nonburstered munitions, failure occurs by rupturing the agent-containing vessel because of internal pressure buildup associated with the addition of heat. The thermal failure thresholds for the various munition types were determined by analysis (Refs. F-4 and F-5). They are shown in Table F-1. Two fire scenarios were considered: (1) direct heating of a munition by an 1850°F fire and (2) indirect heating of a munition whereby the fire heats a 1/4-in. steel plate positioned 6 in. from the munition. The air space between the plate and the munition is considered static with heat transfer occurring by conduction and radiation.

As shown in Table F-1, the results indicate that burster detonation occurs before hydraulic rupture. When subjected to direct exposure to a fire, rockets can detonate in as little as 4 min, and cartridges and projectiles in 6.5 min. A significant increase in exposure time is generally predicted for an indirect fire. This would correspond to the munitions in an uninsulated steel overpack such as a rocket sport, or the vault container to be used for offsite transportation. The corresponding times to reach detonation temperature are 10.5 min for rockets, 75 min for cartridges, and 89 min for projectiles.

The nonburstered munitions are subject only to hydraulic rupture when enveloped by fire. The predicted exposure time to reach failure (Table F-1) is typically about 30 min for direct exposure to fire and typically more than 2 h for indirect exposure.

TABLE F-1
CALCULATED THERMAL FAILURE THRESHOLDS

	Direct Exposure	Indirect Exposure
Cartridges[a]		
Burster detonation	6.5 min	75 min
Hydraulic failure	11 min	>2 h
Propellant ignition	6 min	49 min
Projectiles[a]		
Burster detonation	6.5 min	89 min
Hydraulic failure	12 min	>2 h
Bomb[a]		
Hydraulic failure	35 min	>2 h
Ton containers[a]		
Hydraulic failure	30 min	>1 h
Spray tank[a]		
Hydraulic failure	>2 h	>2 h
Mine[a]		
Burster detonation	16 min[b]	68 min
Rocket[c]		
Buster detonation	4 min	10.5 min
Propellant ignition	5 min	13.7 min
Hydraulic failure	7 min	12 min

[a]One-dimensional calculation with radiation heat transfer.

[b]For individual mine (not in drum), based on test data from Ref. 5-11.

[c]Multi-dimensional calculation with convection and radiation heat transfer.

F.1.4. MECHANICAL FAILURE THRESHOLDS

Limited information was available from other studies to define the munition mechanical failure thresholds. H&R Technical Associates reported both calculated and test results relevant to the M55 rockets (Ref. F-5). In addition, H&R Technical Associates calculated the mechanical failure thresholds for other munitions (Ref. F-6). The results of the calculated crash, impact, and puncture failure thresholds are shown in Table F-2. The results of impact tests available at the start of the risk analysis are summarized in Table F-3. The results of additional impact tests performed in July 1986 are discussed in a subsequent section.

The crush threshold is defined as the static load required to deform the munitions beyond their yield strength. Two crush threshold values are presented in Table F-2, one for axial load and another for a side load. The calculation of the axial, or end crush threshold of a single bare munition assumes that the crushing force is applied parallel to the axis against the end of the munition and that the force is equally distributed over the munition cross section. The weakest portion of the munition cross section is assumed to be the portion of the agent compartment with the thinnest wall. The side crush of a bare munition was calculated based on the assumption that the crushing force applies perpendicular to the axis against the side of the munition and that the force is equally distributed along the length of the munition. The wall thickness is assumed to be uniform along the wall. For the calculation of the end and side crush thresholds of a packaged munition, the smallest end of a pallet was chosen to be crushed on a surface. This assumes a perfectly planar fit between the pallet and its crushing surface. The pallet is also assumed to be resting on a perfectly inelastic massive surface.

The impact threshold is defined as the velocity of impact against an unyielding surface which will deform the munition beyond its failure

TABLE F-2
CRUSH, IMPACT, AND PUNCTURE CALCULATION RESULTS FOR CHEMICAL MUNITIONS

Munition Type	Axial Crush Force(A) (lb)	Axial Impact Velocity(B) (fps/mph)	Axial Impact Height (ft)	Side Crush Force(C) (lb)	Side Impact Velocity(D,AE) (fps/mph)	Side Impact Height(AE) (ft)	Forklift Puncture Velocity(E) (fps/mph)	Road ACC Puncture Velocity(F) (fps/mph)	Rail ACC Puncture Velocity(G) (fps/mph)
Weapons Containing Agent, Fuze, and Burster									
Propellant-Assembled(Z,X)									
115-mm M55 rocket in M441 S/L tube (wt 67 lb)	40,600	57/39	50	20,600(I)	41/28	26			
Palletized weapons - 15/pallet - (wt 1,350 lb)	608,000	49/34	38(AA)	43,400(J)	13/09	3(AA)	1/01	2/01	6/04
4.2-in. M2/M2A1 cartridge (wt 25 lb)	152,000	180/123	503	18,400	63/43	61			
Special M55 pallet calculation(AF)	—	—	—	112,000(AF)	51/35(AF)	40(AF)	—	12/8(AF)	25/17(AF)
Palletized in wooden boxes - 2/box - 24 boxes/pallet (wt 1,700 lb)	7,300,000	149/102	345	110,000	18/12	5(AA)	2/01(K)	5/04(K)	7/05(K)
105-mm M60/M360 cartridge (wt 32 lb)	279,000	216/147	726	61,000	101/69	158			
Palletized in wooden boxes - 2/box - 15 boxes/pallet (wt 1,880 lb)	8,370,000	155/105	371	306,000	30/20	14(AA)	4/03(K)	14/09(K)	20/14(K)
Weapons Containing Agent, Burster									
Assembled - Exposed(Z)									
155-mm M104/M110/M121/M121A1/M122 projectile (wt 99 lb)	621,000	183/125	522	155,000(L)	79/54	97			
Palletized weapons - 8/pallet - (wt 832 lb)	4,960,000	178/122	497	230,000(L)	39/26	24(AA)	5/04	20/14	25/17(AF)
8-in. M426 projectile (wt 199 lb)	1,170,000	178/121	491	181,000(L)	70/48	76			
Palletized weapons - 6/pallet - (wt 1,253 lb)	7,030,000	174/118	468	361,000(L)	39/27	24(AA)	6/04	15/10	22/15
750-lb MC-1 bomb (wt 725 lb)	1,290,000	98/66	148	54,500(M)	40/27(N)	25			
Palletized weapons - 2/pallet - (wt 1,575 lb)	2,580,000	94/64	137	54,500(M)	27/19(N)	11(A)	4/03	8/05	10/07
Assembled in Containers(Y,Z)									
500-lb MK 94 bomb (wt 440 lb)	981,000	109/75	186	35,800(M)	30/20(O)	14			
Containerized weapons - 1/container - (wt 530 lb)							4/03(K)	16/11(K)	23/16(K)
MK-116 bomb (wt 562 lb)	224,000	48/33	33	8,160(L)	13/9(O)	3			
Containerized weapons - 1/container - (wt 851 lb)	486,850	55/38	47(AA)	14,900(L)	22/15(Q)	8(AA)	3/02(R)	8/06(R)	10/07(R)

TABLE F-2 (Continued)

Munition Type	Axial Crush Force(A) (lb)	Axial Impact Velocity(B) (fps/mph)	Axial Impact Height (ft)	Side Crush Force(C) (lb)	Side Impact Velocity(D,AE) (fps/mph)	Side Impact Height(AE) (ft)	Forklift Puncture Velocity(E) (fps/mph)	Road ACC Puncture Velocity(F) (fps/mph)	Rail ACC Puncture Velocity(G) (fps/mph)
Weapons Containing Agent, Fuze and Burster									
Unassembled(Z)									
M23 mine (wt 23 lb)	73,513	131/89	266	711	13/09	3	(W)	(W)	(W)
Containerized weapons - 3/drum - (wt 115 lb)	88,593	64/44	64	18,000(AG)	30/20(Q)	14(AA)	1/01(V)	2/01(V)	3/02(V)
Palletized drums - 12/pallet - (wt 1,337)	531,558	46/31	33(AA)	72,000(AG)	18/12(Q)	5(AA)			
Weapons Containing Agent - in Containers(Y,Z)									
TMU-28 spray tank (1,935 lb)									
Containerized weapons - 1/container - (wt 6,000 lb)	3,390,000	55/38	47	59,900	25/17(T)	10(AA)	10/07(U)	10/07(U)	12/08(U)
Shipping Containers - Agent(Z)									
Type E (wt ~3,000 lb)	969,000	42/28	27	11,900	9/6(N)	1	2/01	2/02	3/02
Type A, D (wt ~3,000 lb)	1,510,000	52/35	42	54,000(AG)	14/10(N)	3(AG)	3/02	4/03	5/03
Overpacked container (wt ~9,000 lb)	2,014,560	35/24	19	12,780(AB)	7/5(AC)	1	7/05(AD)	5/03(AD)	7/04(AD)
Weapons Containing Agent									
105-mm M60/M360 projectile (wt 32 lb)	279,000	216/147	726	61,200	101/69	158	4/03	14/09	20/14
Palletized weapons - 24/pallet - (wt 799 lb)	6,690,000	212/145	698	245,000	41/28	26(AA)			

A. Unless otherwise noted, the calculational model is a simple pipe crushed by an axial force bearing on the pipe annulus.

B. No credit is given for shock absorbing effects of pallet or packing materials. Both the weapon and the pallet or container are assumed to free fall to failure.

C. Unless otherwise noted, the calculational model is a simple pipe with closed ends: the crush force is distributed across the crest of one side with a reaction force at each end creating a bending moment. The weakest side of the pallet was chosen for crush force application where one pallet side was larger than another.

D. No credit is given for shock absorbing effects of pallet or packing materials. Both the weapon and the pallet or container are assumed to free fall to failure. The pallet is assumed to land on its weakest side.

E. A forklift with a mass of 5000 lb requires this velocity to puncture the weapon with a tine. No shock absorbing effects or pallet sliding considered.

TABLE F-2 (Continued)

F. Inside a truck body, a metal rod 1-1/2 in. diameter requires this velocity to be driven into the weapon with the weight of one pallet behind it.

G. Inside a railcar, a metal rod 3 in. diameter requires this velocity to be driven into the weapon with the weight of one pallet behind it.

H. The M55 is close fitted into a shipping/launch tube which is included in the models. The rocket weighs 57 lb; 10 lb are added for the S/L tube.

I. The force required to crush the 40 in. of warhead is used.

J. The force required to crush the saddle supports into the warhead portion of the rockets is used.

K. The wooden box or aluminum container are assumed to provide negligible protection to the munition.

L. The crush force is assumed to bear on only 2/3 of the side of the munition.

M. The crush force is assumed to bear on only 1/2 of the side of the munition.

N. A side wall deformation of 4 in. is assumed to be required for failure.

O. A side wall deformation of 2 in. is assumed to be required for failure.

P. The aluminum container is assumed to provide no protection from crush, impact, puncture.

Q. A side wall deformation of the container of 5 in. is assumed to be required for failure.

R. The puncture probes must travel 4 in. into the container for failure.

S. The TMU-28 wall is assumed to be much weaker than the container wall.

T. A side wall deformation of the container of 12 in. is assumed to be required for failure.

U. The puncture probes must travel 20 in. into the container for failure.

V. The puncture probes must travel 3 in. into the container for failure.

W. The puncture force required to puncture the container is sufficient to puncture the munition also.

X. Some assembled cartridge versions of the M60/M360 are assumed to have been cannibalized for fuzes and propellent.

Y. Fuzes or explosive cutters are assumed to have been removed.

Z. Unless otherwise noted impact and puncture deformations of 1 in. cause failure.

AA. These heights represent perfect impact into a totally massive surface with no energy absorption by the weapon packaging. It is assumed for velocities below about 50 fps (39 ft equivalent height), energy absorbtion by weapon packaging and the surface will dominate the energy of the collision. *In these cases test data are of more value.*

AB. This represents a crush force applied over 36 in. of the thin wall portion of the container.

AC. A side wall defomation of 7 in. is assumed to be required for failure.

AD. The puncture probes must travel 5 in. into the container for failure.

AE. The calculated impact failure threshold data listed were superceded by test data. Therefore, the calculated values are shown for reference only.

AF. A multi-dimensional crush and impact analysis and a sophisticated puncture calculation were performed only for the M55 pallet.

AG. Based on test data.

TABLE F-3
TEST DATA CORRESPONDING TO EFFECTS OF IMPACT

Munitions Configurations	Number Tested	Components Present	Test Dates	Test Procedure	Test Results
Cartridges				No test data available for this report	
Projectiles					
155-mm (no packaging)	1	Burster	1975(a)	25 10-ft drops on steel plate and concrete for: • Base • Side • Nose	No failures for base/side drops, agent compartment failure in 11th nose drop
8-in. (no packaging)	30	Burster	1961(a)	40-ft nose drops on steel plate and concrete	No failures recorded
	30	Burster		40-ft side drops on steel plate and concrete	
	30	Burster		40-ft base drops on steel plate and concrete	
Bomb					
MC-1 750-lb bomb (no packaging)	2	Burster	1955(a)	6-ft side drop on steel plate and concrete	No failures recorded
	2	One with burster only, one with burster and fuze	1955(a)	30-ft side drop on steel plate and concrete	No failures recorded
	2	Fuze/booster	1971(b)	Dropped from plane at 387-ft and 280-mph onto concrete	Hit at 285-mph, bounced 88-ft high, no failures recorded

TABLE F-3 (Continued)

Munitions Configurations	Number Tested	Components Present	Test Dates	Test Procedure	Test Results
Containers					
TMU-28B spray tank (no packaging)	2	Simulant	1973(a)	10-ft side drop on concrete	No failures recorded
	1	Simulant	1966(a)	10-ft side drop on concrete	No failures recorded
	1	Simulant	1968(a)	10-ft side drop on concrete	No failures recorded
Type D ton container (no packaging)	1	Simulant	1964(c)	40-ft drop on steel (end)	Leakage
	1			40-ft drop on steel (35-deg angle)	Major leakage
	1			40-ft drop on steel (side)	Major leakage
	1			6-ft drop on concrete (end, corner, side)	No leakage
Mines					
M23 mine only	3 (8 drops each)	No burster	1958(d)	6-ft drop on steel plate and concrete (side, top, end edge)	Visible leak on last of 24 drops
M23 mine only (prototype)	5 (2 drops each)	Side and central burster	1960(d)	6-ft drop on steel plate and concrete	No leaks
M23 mine only (prototype)	30	Inert bursters agent-filled	1960(d)	3-ft drop on gravel road at 30 mph	One mine had trace leak

TABLE F-3 (Continued)

Munitions Configurations	Number Tested	Components Present	Test Dates	Test Procedure	Test Results
M23 mine only (prototype)	41	Side and central bursters M120 bursters	1960(d)	4-ft drop on concrete slab	Two mines had small leaks
Rockets					
Complete pallet	1	Agent simulant	1964(e)	40-ft drop onto concrete (nose 30 deg below horizontal)	Both end sheets dislodged, one firing tube cracked and enclosed warhead bent so that could not be fired, no agent leaked or propellant function.
Complete pallet	1	All	N/A(a)	40-ft accidental drop onto steel cargo deck, nose down	Pallet "destroyed" scattering all rockets, 14 of 15 rockets damaged, no agent leakage or propellant function.

TABLE F-3 (Continued)

Munitions Configurations	Number Tested	Components Present	Test Dates	Test Procedure	Test Results
Weteye Bomb					
Bomb in shipping container	2	Agent simulant	1965[f]	40-ft drop onto steel plate embedded in concrete (end and side)	For both end and side drop, the shipping container seal no longer effective, bomb nose bent, no agent leakage.

[a]Reference F-7.

[b]Reference F-8.

[c]Reference F-9.

[d]Reference F-10.

[e]Reference F-11.

[f]Reference F-12.

point. The end (axial) and side impact forces on single and palletized munitions were originally determined analytically and whenever possible, supported with test data. Sufficient drop test information was available on the M55 rocket pallets (Table F-3) to determine that simple analyses were not adequate; therefore, multidimensional, nonlinear analyses were conducted (Ref. F-5). This resulted in defining the impact failure threshold as a 40-ft drop height for M55 rocket pallets rather than 3-ft as calculated by simple analysis shown in Table F-2. Therefore, the calculated impact failure thresholds for the other munitions were also considered to be overly conservative, and additional tests were performed at DPG to better define the impact failure threshold for the various munitions. These are discussed in a subsequent section.

The puncture threshold is defined in terms of a ratio of velocity to radius of curvature of the puncture object assuming that the munition (or the pallet) impacts an unyielding slender object. If there is more than one protective barrier, (e.g., mines packaged in drums), the threshold is the velocity required to puncture all the barriers. The puncture failure threshold was determined by calculating the force required to cause material failure with a slender object. During handling operations, munition puncture failures will most likely be caused by forklift tines. The puncture velocity was calculated based on a typical 5000-lb forklift. The munitions are assumed to be in their stored or shipped configuration, as appropriate. Wooden and aluminum containers are assumed to provide no protection to a probe. Some material deformation is also assumed and is consistent with the assumptions made for crush failure threshold calculations. Based on the SNL data base, the calculated truck accident puncture velocity assumed a 3/4-in. radius probe, while the railroad accident puncture velocity assumed a 1.5-in. radius probe. These probe sizes are considered the most probable for truck and rail accidents. In each case, the most likely object capable of acting as a probe was considered to be a trailer/railcar coupler.

F.1.5. ADDITIONAL TEST DATA FOR MECHANICAL FAILURE (IMPACT) THRESHOLDS

In the risk analysis, the objective is to determine the probability that a munition will fail and release agent to the environment. Early Army tests, however, were designed to verify that properly packaged muitions would withstand certain guideline loads rather than to determine the point at which a failure would occur. A summary of various impact tests on chemical munitions is given in Table F-3. The results in Table F-3 indicate that the calculated failure thresholds for impact shown in Table F-2 are too conservative. The one-dimensional mechanical calculations appear to be reasonable for puncture and crush failure, but the modeling is not sufficiently sophisticated to consider the impact energy absorption of the wood, cardboard, and styrofoam protective packaging or the load spreading capability of the shipping configuration. (Multidimensional calculations were performed only on the M55 rocket.) To determine the impact failure thresholds of munitions more accurately, tests were conducted in July 1986 on mines, ton containers, cartridges, and projectiles at DPG. The test results are summarized in Table F-4 and are discussed below. All munitions contained the appropriate quantity of agent simulant. All drops were onto a 10- x 10- x 1-ft concrete slab reinforced with standard bar and angle strips of steel. For some tests, the pad also had a special hard concrete surface.

Two drop tests were conducted with 30-gal drums, each containing three M23 mines. The first drop was from a height of 60 ft such that the side of the drum impacted the cement; substantial leakage of the simulated agent resulted. For a second drop, at 45 ft and in the side orientation, no failures occurred. Figure F-36 shows the three mines after they had been removed from the drum dropped 45 ft. Note that the side of each mine was deformed.

Five ton containers were dropped in eight tests. The first ton container was dropped from three heights, (15, 30, and 40 ft) in a side orientation. After the first test, the ton container was rotated

TABLE F-4
JULY 1986 DROP TESTS

Munitions Configuration	Components Present	No. of Tests	Test Description	Test Results
2 Mine drums containing three M23 mines each	Non-burstered simulant filled	1	45 ft drop, side orientation	Deformation in side of each mine, no leaks.
		1	60 ft drop side orientation	Major leak
6 Ton containers, no overpack	Simulant filled	3 of 1	15, 30, and 40 ft, side orientation	Leak from 4 in. crack after the third drop.
		3	40 ft drop, side orientation	No leaks
		2	40 ft drop at 45 deg angle	No leaks
6 Pallets of 15 M360 105-mm projectiles each	Non-burstered simulant filled	1	60 ft drop, 1 pallet, side orientation	No leakage from any of the tests. Typically, pallet was shattered, but projectiles showed little effects.
		1	60 ft drop, 2 pallets banded together, side orientation	
		1	60 ft drop, 1 pallet, impact along edge	
		1	60 ft drop, 1 pallet, impact on nose ends of projectiles	
		1	60 ft drop, 1 pallet, impact on corner of nose end	
2 Pallets of six 155-mm projectiles each	Non-burstered simulant filled	1	60 ft drop, 1 pallet, impact along edge	No leaks. Projectiles showed only slight effects.
		1	60 ft drop, 1 pallet, impact on corner of nose end	
2 Pallets of 48 4.2 in. mortars each	Non-burstered simulant filled	1	60 ft drop, 1 pallet, impact along edge	No leaks. Boxed generally broken, but no evidence of munition damage.
		1	60 ft drop, 1 pallet, impact on corner of nose end	

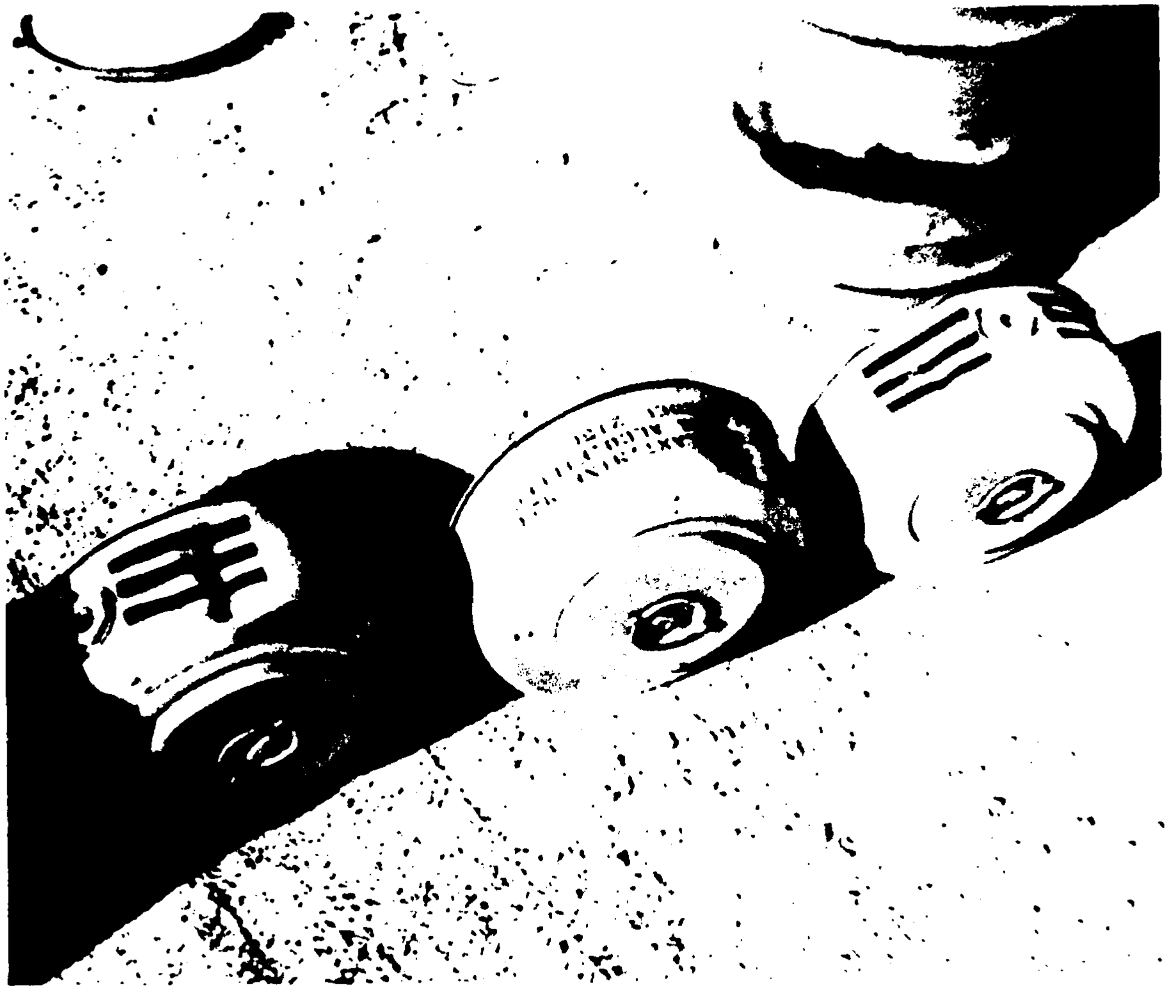


Fig. F-36. Land mines after 45-ft side drop in a 30-gal drum

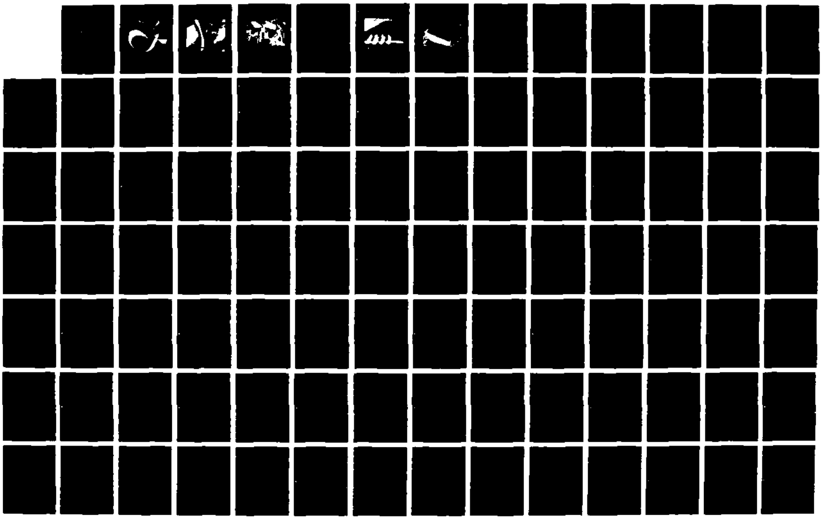
about 90 deg, and after the second test, the cylinder was rotated about 45 deg. The first two tests produced flat spots along the length of the cylinder. On the third drop of the first container, leakage of the agent simulant was observed from a 4-in. long crack on the inside of the protective cylindrical apron in the vicinity of the head weld. Since the crack appeared to emanate from the flat spot created from a prior drop, it was postulated that the failure occurred because of the multiple drops experienced by the cylinder. The postulate was confirmed by three more drops of three separate cylinders, all in a side orientation from 40 ft: no leakage occurred. Figure F-37 shows the flat spot, about 6-in. wide, created by a typical 40-ft drop in a side orientation. Two additional cylinders were dropped from 40 ft, but at a 45 deg angle. The protective apron was bent but no leakage occurred. Figure F-38 shows the deformed apron.

Two pallets of 4.2-in. mortars were dropped from 60 ft, the highest drop height possible with the crane that was used. The orientation of the first drop was such that the edge of the pallet, along the length of the munition, initially impacted the cement. No deformation of the munition itself occurred and no leakage was observed, although most of the wooden boxes were broken open and some of the cardboard tubes were damaged. The munitions were removed (at least partially) from the four cardboard tubes that were the most damaged and stacked in the midst of the undisturbed remnants of the pallet (Fig. F-39). In a second test from 60 ft, the pallet was oriented so that the corner (with the nose of the munition) initially struck the cement. Similar damage to the pallet dunnage occurred, but the munition itself was undamaged.

Six pallets of M360 105-mm projectiles were dropped in five tests, all from 60 ft: (1) a single pallet oriented to strike the side containing the fewest munitions (three); (2) two pallets banded together and oriented to strike the side containing the fewest munitions; (3) a single pallet oriented so that the pallet edge along the length of the munition would initially impact the cement; (4) a single pallet oriented

AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO CA A W BARSELL ET AL. AUG 87 GA-C-18563 11/13

UNCLASSIFIED SAPEO-CDE-IS-87006 DAAA15-85-D-0022 F/G 15/6.3 NL



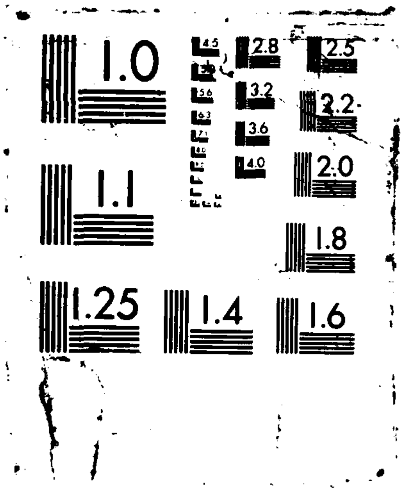

1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

Fig. F-37. Ton container after 40-ft side drop

Fig. F-38. Ton container after a 40-ft drop at a 45-deg angle

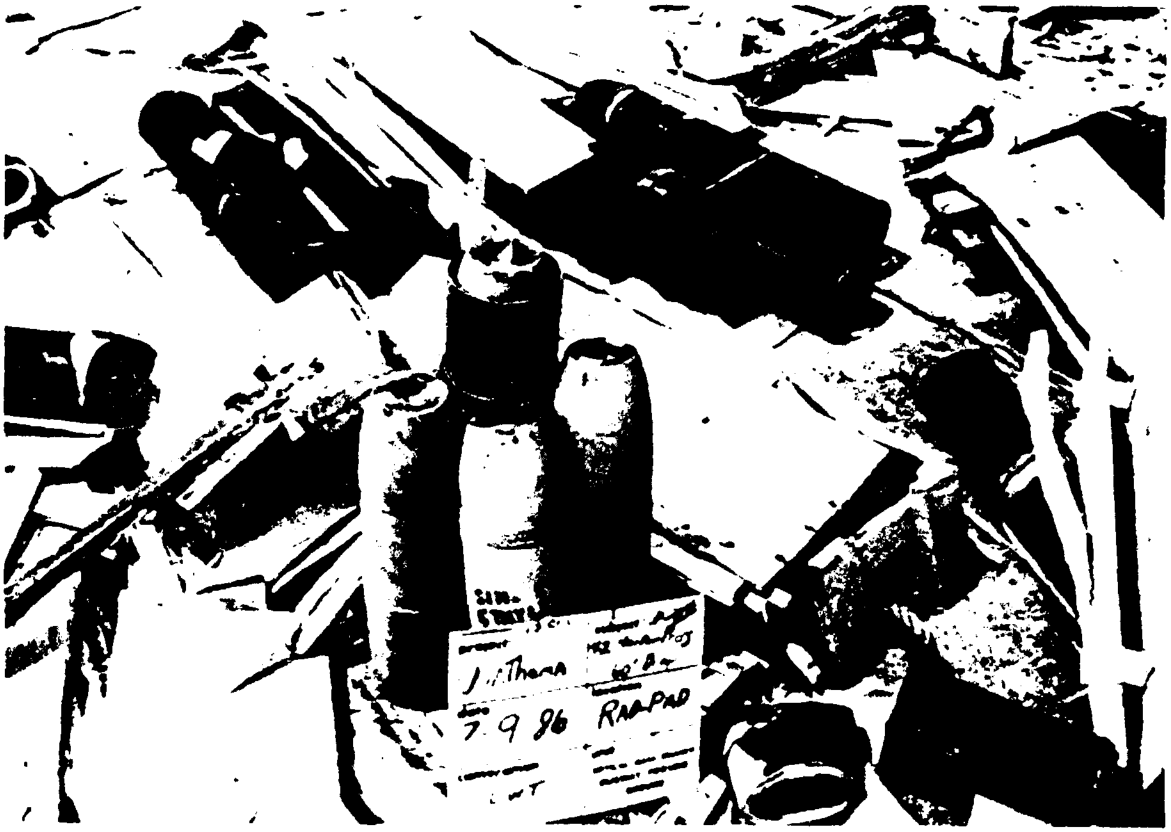


Fig. F-39. 4.2-in. mortar shells after a 60-ft drop from a pallet

so that the 15 nose ends initially impact the cement; and (5) a single pallet oriented so that the corner of the pallet containing the nose of a munition would initially impact the cement. The last test produced the most damage to the munition, but no leakage occurred. Figure F-40 shows that the worst damage was a slightly deformed nose end.

Two pallets of 155-mm projectiles were dropped from 60 ft. One was oriented so that the edge of the pallet along the munition length impacted first and the other so that the corner of the pallet with the projectile nose initially impacted. The munitions generally were undamaged except for the paint and some bruising of the brass rotating band. For the corner drop, the nose ring of the munition in the corner was broken as shown in Fig. F-41.

F.1.5.1. Basis for Selection of Impact Failure Thresholds

The drop test data clearly demonstrated that the calculated failure thresholds are extremely conservative. The drop tests were able to provide a more realistic estimate of the impact failure threshold for rockets, mines, and ton containers. However, the tests were limited to a drop height of 60 ft and no failures or severe damage were observed for cartridges and projectiles. Thus, the actual failure thresholds for these "stronger" munitions could not be established directly from tests. For these munitions, and also bombs and spray tanks, the impact failure threshold was inferred by scaling analytical results using scaling factors obtained from test data on similar munitions.

Rocket. Two rocket pallet drops have occurred from a height of 40 ft (Table F-3); neither produced failure, although in one case the nose of one rocket was severely bent, indicating that the failure threshold for the worst orientation may not be much higher. In addition, conservative calculations indicated failure at 40 ft. Thus, 40 ft was selected as the failure threshold.

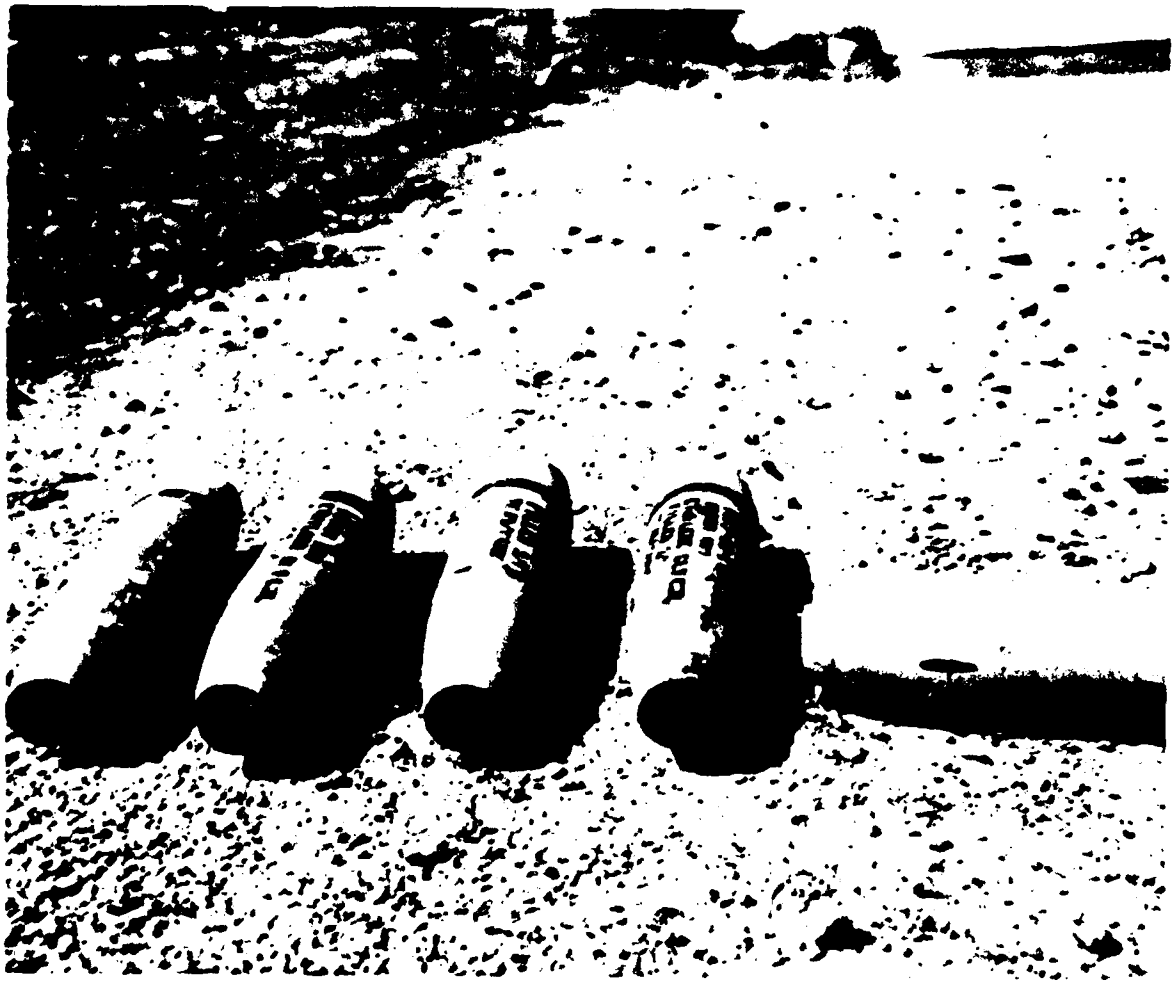


Fig. F-40. 105-mm projectiles of a pallet after a 60-ft drop

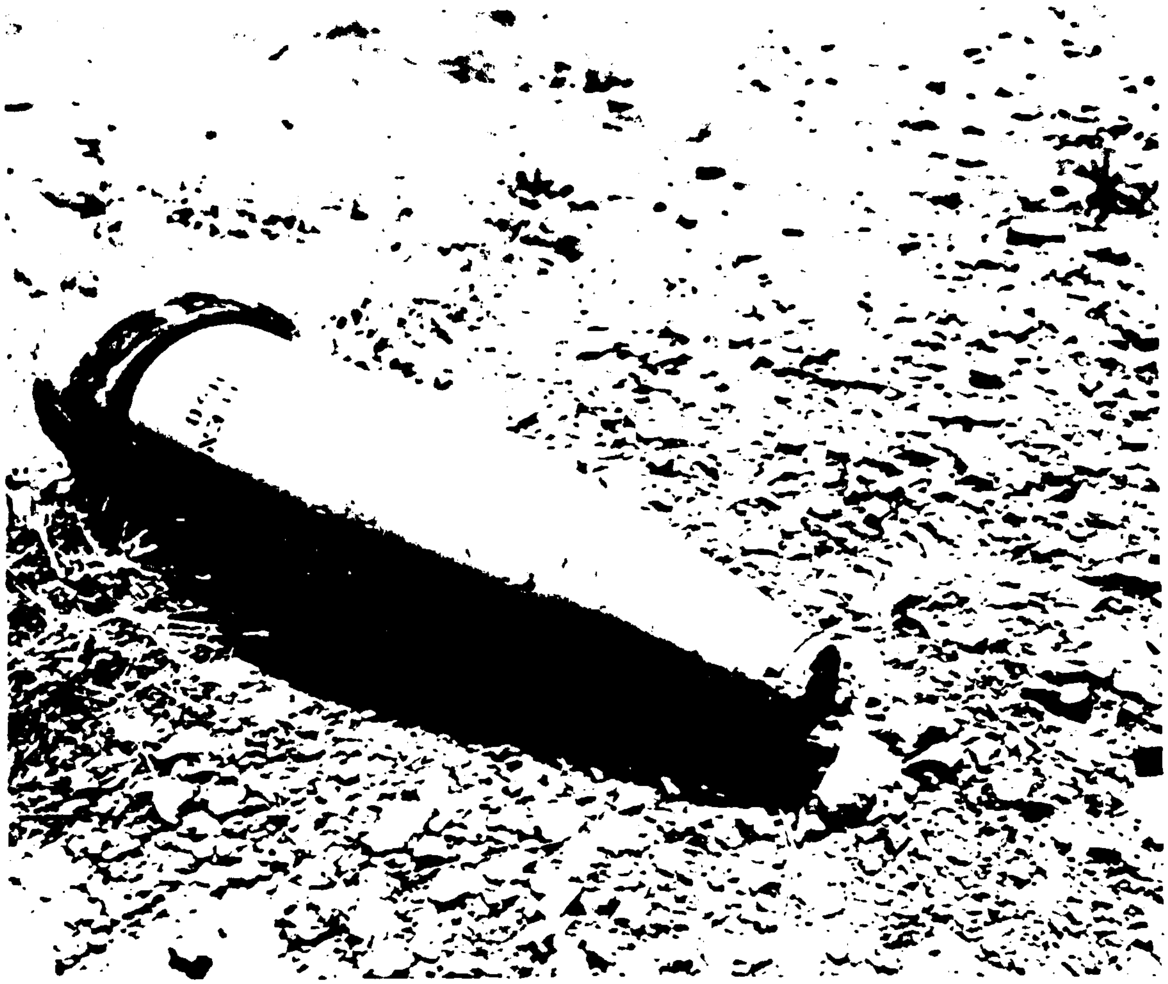


Fig. F-41. 155-mm projectile after a 60-ft drop from a pallet

Mine. Two tests with individual drums of mines resulted in agent containment failure at a drop height of 60 ft and no failure at 45 ft (Table F-4). The mine body deformation at the 45-ft drop height, however, indicated that other drops at 45-ft, or even slightly less, could produce failure. Thus, 45 ft was selected as the failure threshold. Due to the energy absorption capability of the styrofoam packaging, it was judged that the effect of palletizing the drums is negligible.

Ton Container. A prior test produced failure for a 40-ft side drop, and a 40-ft, 45-deg drop (Table F-3). The more recent tests produced no failures for three side drops and two 45-deg drops from 40 ft, using five different ton containers (Table F-4). Failure did occur in one ton container for a side drop from 40 ft after it had already been dropped from 15 and 30 ft. Thus, the failure threshold was selected as 40 ft. The analytical estimate was 3 ft. A scale factor of 13 is obtained between the analytical estimate and the test data.

Bomb. In two prior tests, an MC-1 750-lb bomb was dropped from a plane traveling at a height of 387 ft and a speed of 285 mph (Table F-3). The bomb impacted a concrete runway at an average terminal velocity of 283 mph; the height of the first bounce averaged 88 ft. No leakage of the agent simulant occurred. The impact orientation of the bomb was not given in the test report; however, the vertical component was estimated as 105 mph. The equivalent drop height corresponding to 105 mph is 368 ft. It was assumed that the effect on the bomb more closely resembled a pure axial load rather than a pure side load. The analytical estimate for an axial load was 148 ft (Table F-2).

The bomb is similar to a ton container, and hence the scaling factor of 13 obtained for the ton container for a side load will be used to estimate the failure threshold for a side load on the bomb. The analytical estimate for a side impact load was 25 ft (Table F-2). Hence, the failure threshold for the bomb can be estimated to be 325 ft (25 x 13).

<u>105-mm, 155-mm, and 8-in. Projectiles</u>. Two types of projectiles (105 mm and 155 mm) were dropped from 60 ft (Table F-5) with no observed failures. The M110, 155-mm projectile has a calculated failure threshold of 24 ft (Table F-2). Thus, an apparent scaling factor of at least 60/24 = 2.3 exists between the calculated and experimental failure thresholds. Test limitations precluded dropping projectiles from heights greater than 60 ft; hence, a scaling factor was used to get a more realistic failure threshold. The scale factor of 13 obtained for the ton container was used to determine the failure threshold of projectiles. A failure threshold of 312 ft (24 x 13) was obtained for the 155 mm projectiles. The projectile representative munition is the M426, 8-in. projectile which also has a calculated failure threshold of 24-ft, but no tests were performed with 8-in. projectiles. Hence, the failure threshold for the 155 mm was used as an approximate failure threshold (312 ft) for the 8-in. projectile.

<u>4.2 in. Mortars</u>. Palletized cartridges were calculated to fail at a drop height of 5 ft (Table F-2). In the test, cartridges were dropped from a height of 60 ft (Table F-4), the maximum height permitted by test limitations. There were no deleterious effects on the munitions, only the dunnage was affected. If a scaling factor of 13 is used, an estimated drop height of 65 ft (13 x 5) is obtained. Since no damage occurred at 60 ft, a value of 65 ft is too low. This is partly due to conservative analytical estimate (5 ft) when energy absorption due to dunnage was omitted. The cartridge is weaker than the bomb or the projectile, but should have a failure threshold greater than 60 ft. Hence, in the absence of any other data a mean value (180 ft) between the projectile and test data of 60 ft will be used as an approximate failure threshold for the cartridges (312 + 60/2).

<u>Weteye Bomb</u>. Data reported in the Weteye Final Environmental Impact Statement (FEIS) indicate that the bomb in its shipping container did not fail but was severely damaged for drop tests from 40 ft for

TABLE F-5
ESTIMATED IMPACT FAILURE THRESHOLD FOR MUNITIONS
IN SHIPPING CONFIGURATION

Munition	Failure Threshold Drop Height (ft)	Basis	Scaling Factor
Rocket	40	(a), (b)	--
Mine	45	(a)	--
Ton container	40	(a)	--
Bomb	325	(c)	13
Cartridge	180	(a), (d)	--
Projectile	312	(c)	13
Weteye	40	(a)	--
Spray tank	50	(c)	5

[a] Test data.

[b] Analytical data.

[c] Scaled analytical data.

[d] Limited data available; mean of test data and projectile estimate.

either side or end orientation (Table F-3). The corresponding calculated side drop failure threshold was 8 ft (Table F-2). Thus, the test data show that the failure threshold is at least five times the calculated value.

Spray Tank. The analytical failure estimate for the spray tank was 10 ft (Table F-2). No tests were performed on the spray tank; however, the spray tank in its shipping container is similar to the Weteye bomb in its shipping container. Thus, the scaling factor obtained for the Weteye bomb was used to estimate the failure threshold for the spray tank. A failure threshold of 50 ft (10 x 5) was obtained for the spray tank.

F.1.6. REFERENCES

F-1. "Transportation of Chemical Agents and Munitions, A Concept Plan," report dated June 30, 1987, prepared by the MITRE Corporation.

F-2. Whitney, M. G., et al., "A Manual to Predict Blast and Fragment Loadings from Accidental Explosions of Chemical Munitions Inside an Explosion Containment Structure," Southwest Research Institute, Report No. SWRI-6714, April 1983.

F-3. Dobratz, B. M., "Explosives Handbook, Properties of Chemical Explosive and Explosive Simulants," LLNL, March 16, 1981.

F-4. Rhyne, W. R., Letter to Dr. Rick Bolig dated October 20, 1986.

F-5. Rhyne, W. R., et al., "Probabilistic Analysis of Chemical Agent Release During Transport of M55 Rockets," H&R Technical Associates, Inc., M55-CD-4, H&R 255-1, September 1985.

F-6. Rhyne, W. R., Letter to Dr. C. A. Bolig, March 31, 1986.

F-7. Solomon, I., et al., "Hazards Associated with the Movement of Chemical Munitions and Containers from Dugway Proving Ground to Tooele Army Depot, South Area," Annex L to OPLAN DTS, May 1976.

F-8. Taylor, W. T., et al., "Simulant Phase 1, Test of MC-1 Bomb, Volume I, Final Report," Test 69-14, Deseret Test Center, Fort Douglas, Utah.

F-9. Final Second Supplement to FEIS, Transportation of Chemical Material, Operation RMT, USAMDRC, Alexandria, Virginia, 1981.

F-10. U.S. Army Toxic and Hazardous Materials Agency, "Appendix A, Tests of Chemical Munitions," Handout, April 1984.

F-11. "Hazard Classification Tests for Storage and Handling of GB- and VX-filled Chemical Ammunition, M55 and M23," U.S. Army Test and Evaluation Command, DPGTR-380, May 1964.

F-12. Final Environmental Impact Statement, Transportation of Chemical Materiel, Operation RMT, USAMDRC, Alexandria, Virginia, 1977.

APPENDIX G
DEMILITARIZATION ACTIVITIES

G.1. DEMILITARIZATION ACTIVITIES

As noted in Section 3.1, the steps in the demilitarization process were grouped into five major activities for the risk analysis: storage, handling, onsite transportation by truck, offsite transportation by rail, and demilitarization operations. Each of these activities, as well as decommissioning, is discussed in detail in the sections which follow.

G.1.1. STORAGE

Safe storage of the chemical munitions is required up to the time they are processed in a demilitarization facility. It is assumed that the current storage arrangement will continue until a process facility or facilities are ready for operation. Large-scale movement of chemical munitions must take place within the constraints of the program schedule, plant operating schedules, logistical limitations of transport operations, availability of storage facilities at the NDC or RDC, and in compliance with safety and regulatory requirements of transport.

Munition movement sequences are generally planned to coincide with plant disposal sequences. Munitions would be moved as storage space is created by disposal plant operations. Ideally, movement would be accomplished in advance of disposal operations to ensure that stocks are in place and that plant operations are not delayed.

For the purposes of this risk analysis, it has been assumed that storage basically occurs at the original storage site. However, handling activities were accounted for at both the sending and receiving sites as though the munitions were placed into a similar storage facility at the receiving site.

Storage of chemical munitions is governed by the general safety guidelines of AMC-R 385-100 (Ref. G-1). Specific regulations for the storage of GB and VX are given in DARCOM-R 385-102 (Ref. G-2), and in DARCOM-R 385-31 (Ref. G-3) for mustard types H, HD, and HT. In accordance with these regulations, it was assumed that the munitions are stored as follows:

1. Magazines or structures used for the storage of agent-filled items are in specially designated areas. The structures have floors and floor surfacing that can be decontaminated.

2. Munitions that contain explosives are stored in igloo magazines. The igloos are spaced according to hazard class and the quantity of explosives that the igloo is permitted to hold.

3. Munitions and bulk containers containing GB or VX, but containing no explosives, are stored in igloo magazines except VX ton containers are in warehouses at NAAP, and VX spray tanks are stored in warehouses at TEAD.

4. Munitions containing mustard, but containing no explosives, are stored in igloos or other approved structures. Bulk containers containing mustard are also stored outdoors at APG, PBA, and TEAD. Mustard-filled bulk containers stored outdoors are secured on metal supports and positioned over crushed stone, gravel, or porous earth surfaces to minimize atmospheric contamination in the event of leakage.

5. Munitions in storage are packaged, stacked, and arranged in accordance with instructions set forth in Army regulations and approved AMC drawings and directives. The methods for stacking provide adequate ventilation. Aisles are maintained so

that units in each stack can be inspected, inventoried, and removed for shipment or surveillance tests.

6. The ends of ton containers are kept freshly painted and rust-free to enhance visual detection of agent leakage at valves and plugs. Shipping bonnets are removed from ton containers in storage to facilitate inspection for leakage. If a leaking container is found, the leak is repaired, or the contents are transferred into a new container.

7. Work performed in magazines and storage areas is limited to the types permitted in Chapter 18 (Storage of Explosives and Ammunition) of AMC-R 385-100.

8. Leaking munitions are encapsulated in specially provided containers until disposition is accomplished.

Three types of storage magazines are currently in use: igloo magazines (in 40-, 60-, and 80-ft lengths), 80-ft Stradley magazines, and 89-ft oval-arch magazines. While size and design details differ, they are all earth-covered, arched-roof structures designed to protect their contents from the blast and shrapnel effects of a potential detonation of a neighboring magazine. For this risk analysis, except as noted for specific accident scenarios, the structural characteristics of all the storage magazines are represented by the 80-ft igloo magazine. General design characteristics of the 80-ft igloo magazines are listed below (Ref. G-4):

1. The minimum compressive strength of the concrete used in igloo construction is 2500 psi.

2. The minimum concrete thickness of the igloo arch is 6 in. at the crown of the arch, and the minimum thickness is 16 in. at the foundation footing.

3. The minimum thickness of the exposed concrete front face of the igloo is 18 in.

4. The minimum thickness of the earth cover is 24 in. at the crown of the arch. The earth cover has a maximum slope of two horizontal units to one vertical unit and is stabilized by establishing a controlled vegetation cover such as grass, or by mechanical means appropriate to the local soil conditions and climate.

5. The igloo is designed to prevent water ingress. Preventative measures include membrane waterproofing, a perforated drain system along foundation footings, interior floor slope and gutters, and slope of the concrete entry apron away from the front of the igloo.

6. Passive ventilation is provided in the form of louvered vents in the front concrete face of the igloo and a single ventilator stack penetrating the earthen cover at the rear of the igloo. The stack ventilator is designed to prevent backdrafts.

   Fusible links are provided in the vents to close the ventilation path in the event of a fire.

7. Single or double doors, which open outward, are provided in the front face of the igloo. Double doors create an opening measuring 8 by 8 ft. A reinforced concrete "King Tut" block is provided in front of each door as a security device. The

block weighs approximately 5000 lb and rests on a post embedded in the concrete apron in front of each igloo; a forklift is required to remove the block from in front of the igloo door. In addition, the doors are padlocked shut with high-security locks.

8. A lightning protection system is provided.

9. No electric power system is permanently installed in the igloos; however, an electrical junction box is provided on the outside front face of each igloo.

10. No fire fighting system is installed in or near the igloos; however, depot fire fighting teams are located within a few minutes response time from the storage locations. In addition, all nonelectric vehicles are required to carry fire extinguishers when operating in or near the ammunition storage areas. Also, while personnel are operating in the igloos, one or more decon trucks carrying a large supply of water is kept on standby immediately outside the igloo. This water supply can be used for emergency fire fighting if required.

11. An intruder alert system is installed in all igloos.

Warehouses are in use at three sites to store bulk containers. The size and construction of the warehouses are different at each of the three sites. Descriptions of the warehouses are provided in the discussion of site-specific data in Appendix D.

Any munitions in open storage (mustard-filled ton containers) are stored in configurations specified in AMC drawings, but are otherwise unprotected from the elements.

Detailed information on pallet configurations is given in the Continued Storage Risk Analysis report (Ref. G-5).

G.1.1.1. Activities Associated with Storage

The activities associated with munition storage consist of surveillance and maintenance of the stored munitions, surveillance and maintenance of the storage facilities, and inventory of stored munitions. It is assumed that all surveillance will be accomplished in accordance with IAW SB 742-1300-94-1 (Ref. G-6). Three types of inspections are conducted; these are periodic inspections (PI), safety in storage inspections (SSI), and storage monitoring inspections (SMI).

Periodic inspections are cyclical inspections of the munitions for deterioration or nonstandard conditions. Periodic inspections are conducted at 2-yr intervals on all chemical munitions, unless conditions warrant more frequent inspection. (PI does not apply to munitions in demilitarization accounts.)

Safety in storage inspections are periodic inspections of unserviceable, nonrepairable munitions and munitions in demilitarization accounts, conducted to assure that the munitions are safe for continued storage, handling, and demilitarization. Visual inspections are supplemented by propellant stability testing. Lots that are considered potentially hazardous are inspected no less frequently than the intervals specified for PI. Lots determined to be nonhazardous may have their SSI intervals extended, but the extended interval may not exceed twice the PI interval.

Storage monitoring inspections are performed on chemical agent munitions, containers of bulk chemical agents, and containerized munitions specifically to detect leakers and any other visual defects. Frequency of SMI is as required by technical instructions for the specific item.

At a minimum, all storage facilities (magazines, warehouses, etc.) are inspected at quarterly intervals. The inspections consist of both internal and external visual examinations. Other than appropriate protective clothing and flashlights, no special equipment is required. No moving or restacking of pallets is involved. The inspections address the following:

1. Exterior

- Structural integrity.
- Condition of storage area.
- Vegetation control.
- Clear of dried debris.
- Firebreaks cleared.
- Adequacy of earthen cover.
- Condition of doors and ventilators.
- Correct type of fusible link on vents.
- Lightning protection system.
- Condition of service roads.

2. Interior

- Condition of munitions.
- Compliance with storage drawings.
- Lot segregation.
- Stability of pallet stacks.
- Adequacy of aisles.
- Absence of unauthorized materials or equipment.
- Containers are not damaged.
- Presence of proper records.

- Evidence of termites, rodents, water leakage, or other nonstandard conditions.

Visits to each of the chemical storage sites by the members of the analysis team indicate that the condition of the storage facilities with respect to the above characteristics has been excellent. Only minor repairs for water leakage on igloos have been required.

An enhanced storage monitoring program is in place for the rockets, some of which have experienced vapor leaks. Typically, the inspection involves a three- or four-man team and consists of walking the aisles between the stacks of pallets and making an initial visual inspection for observable signs of agent leakage. Lighting for the storage monitoring inspection is provided by powerful hand-held flashlights. If signs of leakage are found at any time during the inspection, masks are donned and the area is cleared. Following visual inspection, a munition is selected at random for air sampling of the interior of the shipping and firing tube. Sampling is accomplished in Level B or Level A protective clothing (see Table G-1). The inspection procedure involves no moving or restacking of pallets (unless a leaker is found). All equipment is located on a self-contained cart, which is rolled into the igloo by hand.

Ton containers that are stored in igloos or warehouse buildings are inspected for leakage quarterly (Ref. G-6). Ton containers stored in the open are also required to be inspected quarterly (Ref. G-7). A number of these containers (primarily ton containers with GB) have experienced severe corrosion of the brass fill and drain valves, and some have experienced corrosion in the area of the threaded plugs installed in the container ends. The current plan is to replace the brass valves with stainless steel valves on all GB ton containers. The same degree of corrosion has not been associated with agents other than GB. The corrective procedure for containers containing those agents has been to replace the corroded valves or plugs. This is accomplished with

TABLE G-1
PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT[a]

Protection Level					
A (GB and VX)	B (GB and VX)	C (GB only)	D (VX only)	E (GB or VX)	F (GB or VX)
Protective Clothing					
Suit, TAP[b] (M3) Coveralls, fatigues or protective liner Hood, TAP (M3) Butyl boots with safety toe, TAP (M2A1) Butyl gloves (M3 or M4) Undershirt Drawers Socks Mask-worn (M9 series)	Coveralls or fatigues Hood, TAP (M3 for M9 mask or M6A2 for M17 mask) Butyl boots with safety toe, TAP (M2A1) Butyl apron, extending below top of boots (M2) Butyl gloves (M3, M4, or glove set) Undershirt Drawers Socks Mask-worn (M9 or M17 series)	Coveralls or fatigues Butyl boots with safety toe, TAP (M2A1) Butyl gloves (M3, M4, or glove set) Undershirt Drawers Socks Mask-worn (M9 or M17 series)	Coveralls or fatigues Butyl boots with safety toe, TAP (M2A1) Butyl gloves (M3, M4, or glove set) Undershirt Drawers Socks Mask, slung (M9 or M17 series)	Coveralls or fatigues Safety shoe (if required) Butyl gloves (M3, M4, or glove set)[c] Mask-slung (M9 or M17 series)	Street attire Mask, slung position (M9 or M17 series)
Conditions Required					
Area of spilled agent or liquid contamination Storage operations Sampling operations Material handling Maintenance operations Fire fighting/chemical accident/incident control	Area of suspected agent or agent vapors First entry monitoring of outside storage areas Trained emergency personnel responding to an accident Loading and charging the M9 or M12 decontaminating apparatus	Immediate operating area where suspected contaminated items or equipment are present No contact with contaminated items is required	Immediate area of outside operations where suspected items or equipment are present No contact with contaminated items is required	Worn by observers or supervisors of operation and laboratory personnel	Worn by visitors, casuals, supervisory, or operations control personnel in area where hazardous materials are stored or in clean operating areas

[a]This table presents a brief summary of the data presented in Ref. G-4.

[b]TAP - toxicological agent protective.

[c]Only for operation when GB/VX containers are handled.

the container filled with agent. While implementing these procedures, Level A protective clothing is worn by all personnel in the immediate vicinity. The procedures involve removing the leaking container from its storage igloo and lifting the container onto a special fixture which will permit the container to be tilted from a horizontal to a vertical orientation. The lifting operation is accomplished with an electric forklift, using an M1 lifting bar which is specifically designed to lift a ton container in a horizontal position by engaging both ends of the container with self-locking hooks. Once the container is placed in the fixture, it is tilted to the vertical orientation with the valve end pointing up. The leaking valves are removed, the threads in the container are recut, as required, and a new valve is installed in its place.

Visual examination of the ton containers also reveals the degree of rusting that the containers are experiencing. Specific criteria for allowable rusting are given in SB 742-1 (Ref. G-6). In general, the ton container will be placed in condition Code E and scheduled for derusting and repainting if any of the following occur:

1. Minor rust on the ends of the container exceeds 25% of the container surface.

2. Sufficient rust exists in the vicinity of the valves to hinder the detection of agent leakage.

3. Rust or corrosion on the cylindrical surface of the container has progressed to the point of a scaly, granular, or flaked condition, accompanied by definite pitting or etching of the material.

4. Rust or corrosion has progressed to the point where the identification markings on the container are threatened to be rendered illegible.

G.1.2. ONSITE TRANSPORTATION

Transport of munitions on military reservations is, essentially, the movement of these munitions between an interim storage area and an onsite railhead or disposal facility. Generally, this movement is characterized by locating a transport vehicle at the loading apron, loading the transport vehicle, traveling to an unloading station, and unloading the vehicle. For the NDC and RDC alternatives, onsite transportation includes transportation between the storage igloo and an onsite railhead at both the shipping and receiving end.

At APG and NAAP, munitions will be moved from storage to the railhead by forklift. At all other storage sites, chemical munition movement will take place using either an enclosed trailer or a stake and platform trailer. These trailers are designed for ease of cargo handling with a forklift/pallet system.

The enclosure trailer is similar to any van-type trailer with the addition of a roller-conveyor unit in the trailer floor. The use of the trailer permits forklift loading of pallets through the end of the van body, minimizing forklift travel. Once in the trailer, the pallet is manually rolled to its position and secured. The trailer is unloaded in reverse at its destination. The use of the enclosed trailer in this manner provides some basic thermal and mechanical protection of the munition pallets and leakage containment by the van body.

The stake and platform trailer is a large trailer designed for side loading. With the sides removed, pallets can be loaded directly onto all points of the trailer floor by forklift. The use of either the enclosed trailer or the stake and platform trailer, negates the requirement for special loading ramps for forklifts.

Once the transport vehicle is loaded, the pallets are secured to prevent the load from shifting during movement. Blocking devices, which fit into the roller-conveyor, are used to secure pallets in the enclosed

trailer. Wooden chocks and blocks are spiked into the stake and platform trailer to secure the pallets.

Movement of munitions will take place within the chemical munition exclusion area on existing and/or newly constructed roads. Specific road conditions vary from site to site. At some sites, the roads are essentially flat; at others, the roads are hilly with steep grades. The road surface itself also varies in condition and type. In addition, obstacles such as utility poles are present at some of the reservations, while others have none. The immediate surrounding terrain also varies in each case from sandy and flat to firm clay with ravines.

Equipment to mitigate the effects of a transport accident are present with the munition transporter. This equipment includes fire fighting and decontamination equipment that is fully manned and ready.

G.1.3. OFFSITE TRANSPORTATION

Three basic methods have been considered for transporting M55 rockets within the United States: military aircraft, military truck convoy, and munition trains. A probabilistic analysis of agent release (Ref. G-8) resulting from transportation accidents involving these rockets indicated that munition trains were the preferred mode for offsite transportation. This analysis also evaluated a packaging configuration referred to as an offsite transport container (OFC) for shipping the M55 rockets. The current disposal plan (Ref. G-11) indicates that M55 rockets, M23 land mines, 4.2-in. mortars, and 105-mm cartridges are to be transported offsite in an OFC. The first two munitions are especially hazardous because they are relatively thin-walled and contain explosives. The latter two items are considered hazardous because they are fuzed and shipped with propellants and explosives. Because they have the potential to release a large quantity of agent, ton containers are also assumed to be shipped in the OFC.

The OFC technology builds on the transport package developed for the U.S. Department of Energy for protection of radioactive materials during transport (Ref. G-9). The OFC is designed to provide for the containment of agent vapors with crush and puncture resistance and insulation from fire. The rail version of the OFC weighs approximately 48,000 lb and can hold 15 pallets of M55 rockets. Two rail OFCs can fit on a flatbed railcar.

Rail convoys would consist of two separate trains: an 18-car pilot train consisting of support cars for personnel and backup emergency response cars, and the munition train consisting of 50 munition cars and 18 support cars. A third train of unspecified length may be present for the purpose of carrying emergency medical supplies for response to an accident in the event of a catastrophic agent release. The munition trains would carry sufficient equipment and personnel to provide security to the cargo, to control accidental agent release, and

to provide treatment to personnel accompanying the movement. A typical makeup of munition trains is shown in Tables G-2 and G-3.

Munition cars would be loaded and unloaded inside the chemical exclusion areas at the shipping and receiving depots. This requires extension of a rail spur into the exclusion areas capable of holding 50 cars (flatbed cars for OFCs and standard boxcars for palleted projectiles) and/or extension of the areas to surround existing rail sidings. The rail facility would be engineered during preparation of a detailed transportation plan. To permit the entire train to be prepared for movement in 7 days, a relatively long loading dock would be required, allowing the simultaneous loading of 5 to 10 railcars.

Trains would move continuously, day and night, at an average speed of about 15 mph (maximum speed 35 mph) over routes chosen to bypass large population centers. Specific routes will be established with the rail carriers as part of a detailed transportation plan. Rail beds will be inspected and repaired or upgraded as necessary, prior to and during the movement campaign.

Munition trains will be accompanied by relays of surveillance helicopters during daylight hours. All grade crossings and overpasses will be guarded by civilian police or military personnel during use. Train movements will be carefully coordinated in advance with appropriate state and federal emergency response forces along the route.

To minimize temporary storage in rail cars, the rate for transporting munitions from the existing CONUS sites to the demilitarization site should match the plant process rate. The plant process rates and the optimum transportation requirements for the NDC and RDC alternatives are shown in Tables G-4 and G-5, respectively.

TABLE G-2
MUNITION TRAIN REQUIREMENTS[a]

Item	Munition Train	Pilot Train
Munition cars	50	0
Tanker	1	1
Decontamination	1	1
Pullman	0	6
Diner	0	1
Guard and support personnel cars	10	1
Ambulance	0	1
Communications support	2	1
Ramp	0	1
Spare trailer	0	2
Spare tractor	4	3
Laboratory car	1	1
Total	69	19

[a]The requirements for the medical supply train have not yet been defined and therefore were not included in this table.

TABLE G-3
PERSONNEL ACCOMPANYING RAIL MOVEMENT

Type	Number
Guards for munitions cars	100
Guards for munitions train (other than munitions cars)	15
Guards for pilot train	27
Support personnel for munition train (medics; drivers for trucks, ambulances, forklifts, crane, and heavy equipment; mechanics; radio operators; etc.)	38
Support personnel (as above) for pilot train	35
Command and control team for munition train	10
Technical escort personnel	18
Total	243

TABLE G-4
NATIONAL DESTRUCTION CENTER TRANSPORTATION REQUIREMENTS

Munition	Process Rate[a,c] wk	No. of Munitions Railcar	No. of Munitions Train	Delivery Rate Trains/wk
Rocket	14,400	450[b]	30,000	0.48
4.2-in. mortar	62,640	1,056[b]	52,800	1.18
105-mm cartridge	71,280	600[b]	30,000	2.38
155-mm projectile	36,720	1,088	54,400	0.68
8-in. projectile	14,760	516	25,800	0.57
Mine	20,160	1,080[b]	54,000	0.37
Ton container				
GB	360	144	600	0.60
VX	240	144	600	0.40
Mustard	420	144	600	0.70
MC-1 750-lb bomb	1,548	144	7,200	0.21

[a]Basis: 120 operating hours per week at the average throughput of JACADS facilities. The national site employs two JACADS bulk plants as well as three standard JACADS plants.

[b]Shipped in a CAMPACT.

[c]Reference G-11.

TABLE G-5
REGIONAL DESTRUCTION CENTERS TRANSPORTATION REQUIREMENTS

Munition	Process Rate Per Week[a,c]		Number of Munitions Per Train	Delivery Rate, Trains per Week	
	Tooele	Anniston		Tooele	Anniston
Rocket	9,600	4,800	30,000[b]	0.32	0.16
4.2-in. mortar	41,760	20,880	52,800[b]	0.80	0.40
105-mm cartridge	47,520	23,760	30,000[b]	1.58	0.79
155-mm projectile	24,480	12,240	54,000	0.45	0.23
8-in. projectile	9,840	4,920	25,800	0.38	0.19
Mine	13,440	6,720	54,000[b]	0.25	0.12
Ton container					
GB	216	144	600[b]	0.36	0.24
VX	144	96	600[b]	0.24	0.16
Mustard	252	168	600[b]	0.42	0.28
MC-1 750-lb bomb	1,032	516	7,200	0.14	0.07

[a]Basis: 120 operating hours per week at the average throughput of JACADS facilities. Regional sites employ one each JACADS and bulk plants at ANAD with two JACADS and one bulk plant at TEAD.

[b]Shipped in CAMPACT.

[c]Reference G-11.

Special munition trains will be used for rail transportation. Each munitions train will be preceded by a pilot train. The munitions train is configured so that the cars are divided into groups with buffer cars containing inert material between the groups. Five cars containing inert material are placed between the locomotives and the first munitions car. The composition of typical munitions and pilot trains is shown in Table G-6. The number of ammunition cars was assumed to be 70 for the analyses in this report, with about 50 support cars.

The effect of human factors on the train accident rate (Section 9.2) is implicit in the SNL data base. If an accident occurred due to human error, it shows up in the data base just as an accident. Therefore, it is not possible to ascertain the human error contribution or to define the human error probabilities involved. No specific human reliability analysis was done for rail transportation.

Extensive administrative controls will be in effect during rail transportation, however. These controls are described briefly below. For all rail transport, a 10-person command and control team will be located at both the shipping and receiving sites, and another will accompany the munitions train. A technical escort team will also accompany the munitions during transport. It is assumed that emergency response to a train accident by the pilot train will be within 1 h, with any accident agent release contained within 6 h.

Each transport vehicle will only carry one type of chemical agent (e.g., all VX or all GB) and one kind of munition at a time. The munitions train may transport more than one munition type but only one agent type per trip. The vehicles will be inspected before each planned movement.

TABLE G-6
MAKEUP OF THE MUNITION AND ESCORT TRAIN
IN A RAIL CONVOY[a]

Type of Railcar	Escort Train	Munition Train
Munition (loaded)	0	70
Munition (empty)	5	0
Buffer	0	33[b]
Tank	1	1[c]
Decontamination	2	2[c]
Passenger	3	0
Guard	0	7[d]
Support equipment	4	[c]
Container overpack[e]	2	0
Radio support	1	2
Laboratory	1	1
Medical	1	0
Command	0	1
Totals	20	117

[a]Reference 8-12.

[b]Five cars between the command car engines and the first munition car. Two cars between cars carrying Army personnel and munition cars.

[c]Will be used as buffer cars.

[d]Guard cars will be interspersed among the munition cars. They are likely to be modified passenger cars.

[e]Overpack containers will be carried on 89-ft flatcars.

The munition and pilot trains are limited to a maximum speed of 50 mph and will stop only for engine changes, crew changes, and munition car inspections. At 1000-mile intervals, the train will stop for equipment checks; cars will be inspected and monitored concurrently.

G.1.4. HANDLING ACTIVITIES

The following paragraphs describe onsite facility handling activities as they are presently defined for the JACADS facility. Unless another reference is specifically cited these descriptions were taken from the JACADS final design description (Ref. G-10). When it is apparent that differences are required for handling activities at other processing sites, these differences are described. Although the risk analysis did not address specific accident scenarios involving the handling of leakers, normal handling procedures for leaking munitions as described in Ref. G-10 have also been presented.

One condition that may vary from site to site and possibly from igloo to igloo within a site is the relative levels of the pavement inside and outside the entrance to the igloos. Because of differences in floor/ramp level inside and outside the igloo, munitions that are being transported from an igloo are placed on a pad outside the storage igloo to be picked up and loaded onto the transport truck by another forklift. The forklift used outside the igloo may be either electric, gasoline, or LPG powered.

Standing operating procedures exist for continuous monitoring and periodic inspections to identify and isolate leakers of all munition configurations. When preparing for munition removal from an igloo, it is particularly important to identify and isolate leaking munitions so that they may be decontaminated, overpacked, and segregated until processed in a separate campaign. To do this, munitions other than ton containers and spray tanks must be removed from their pallets and handled separately. (Ton containers and spray tanks are always handled singularly.) Normally, no lifting equipment, other than an electric forklift truck, is available for handling single munitions.

When a leaking munition is removed from a pallet, a nonleaking munition of the same configuration and lot number is normally inserted

in place of the leaker to keep the pallets fully populated. In this way there is only one broken pallet in a given munition lot.

At the demilitarization facility, munitions arrive in their normal packaging units either from the MHI or directly from the storage igloo. From the MHI, munitions will be delivered by forklift directly into the elevator and then to the UPA. Munitions coming directly from the storage igloos to the MDB will be transported by a flatbed munition truck or a munition van. On arrival at the MDB, a forklift will be used to unload munitions from the truck and place them in the elevator.

G.1.4.1. Projectiles and Mortars

Each of the 105-mm M60 and M360 cartridges are currently stored in a fiber tube container, with two fiber tube containers per wooden box, and 12 or 15 boxes per pallet. Each 4.2-in. M2/M2A1 mortar cartridge is stored in a fiber tube container, with two fiber tube containers per wooden box, and 24 wooden boxes per pallet.

For the purpose of this study, it was assumed that there will be a special area, separate from the demilitarization facility, where cartridges will be unpacked, the propellant and ignition cartridge removed, and the projectiles repacked in a configuration of 24 munitions per pallet. The mortar propellants which are removed will be placed into 4-in. diameter, 18-in long, thin metallic pipes. The ends of these pipes will be capped with plastic lids. These tubes with propellant and cartridge cases with primers will be fed to the deactivation furnace system (DFS) through the mine and rocket transport conveying system in a separate campaign. This approach is similar to that for the JACADS plant. However, the U.S. Army is also considering other approaches to be used at the CONUS sites for removal of propellant from these cartridges.

Projectiles are strapped directly to wooden storage/shipping pallets. The pallets contain either twenty-four 105-mm projectiles, eight 155-mm projectiles, or six 8-in. projectiles.

G.1.4.2. Rockets

Each M55 rocket is encased in a fiberglass shipping and firing tube that has aluminum nose and tail closures. Fifteen rocket tubes are strapped onto a wooden storage/shipping pallet. Rocket pallets are moved in their as-stored configuration to or from the railhead. At the railhead, the pallets are placed in an OFC.

At the NDC or RDC, rocket pallets are placed in SPORTS and into onsite containers (ONC) prior to being transported to the MDB. Each transport truck will carry up to four ONCs with 15 rockets per ONC. The rocket pallets and ONCs are handled inside the storage igloos by electric forklift trucks.

G.1.4.3. Mines

Mines are packed three to a drum along with three M603 fuzes and three M1 activators. Mine pallets (12 drums per pallet) are moved by forklift to the ONC for transport to the MHI. From the MHI, another forklift is used to transfer mine pallets in the ONC into the MDB, and subsequently to the UPA.

G.1.4.4. Bulk Items

MC-1 750-lb bombs are stored two-to-a-pallet while the MK-94 500-lb bombs are not palletized. Ton containers are not palletized in storage. They are moved by forklift but are placed onto the forklift using an M-1 or similar type lifting beam. Spray tanks are stored without pallets in customized containers. For this analysis, it is assumed that spray tanks are normally handled using forklifts.

G.1.5. MUNITIONS DEMILITARIZATION

The proposed NDC site for the disposal of the total CONUS stockpile would be located at TEAD. The NDC site would consist of five facilities for processing the munitions and bulk agents, each sized for the JACADS process rates.

Three of these facilities would be identical to the JACADS facility with capability for processing munitions and bulk agent. Two JACADS-adapted facilities would process bulk agent only. The current CAMDS facility will be modified to incorporate the JACADS process equipment, and would comprise one of the two bulk process lines. The second bulk facility would be a new JACADS-adapted bulk facility. Multiple JACADS-type facilities would be utilized to minimize the required time for design, procurement, and construction, thus maximizing the time period remaining for disposal operations.

The plan for the RDC is to provide two regional disposal facilities, one at TEAD, and the second at ANAD. The RDC at TEAD would consist of three facilities: two JACADS-type facilities for processing munitions and bulk agent plus a modified JACADS-adapted CAMDS facility to process bulk agent only. The Anniston RDC would consist of two facilities: one JACADS-type facility for processing munitions and bulk agents and one JACADS-adapted bulk-only facility.

G.1.5.1. Baseline Technology

The demilitarization facility evaluated in this study is based on the JACADS process and consists of an integrated munition-handling system to process all of the different types of munitions and agents. All demilitarization will be performed in the MDB, which houses the UPA, rocket and mine punch-and-drain machine, projectile mortar disassembly machine, rocket and burster shearing machine, mine machine for booster removal, a bulk drain station (BDS) to punch/drain bulk items, agent

transfer equipment, a toxic cubicle (TOX) for agent storage tanks, and furnaces for explosive deactivation, agent incineration, metal parts decontamination, and dunnage incineration. All furnaces will have afterburners to ensure complete agent destruction. Each furnace has its own pollution abatement system (PAS).

Revisions to the JACADS design will be necessary for site adaptation (Ref. G-12). Some of the revisions are listed below:

1. Equipment weather enclosures will be added for all process equipment which will be located outdoors, i.e., pollution abatement system (PAS), brine reduction area (BRA), and bulk chemical storage (BCS).

2. All fuel burning equipment, ducts, and fans will be resized for higher altitude and different fuel, where applicable.

3. Rooms will be resized to provide any additional space necessary to accommodate the changes noted above.

4. The structural design for the building and equipment supports will be evaluated and revised, if required, to meet higher seismic loads.

5. Refrigerated plant air dryers will be changed to desiccant type to prevent water condensation in outdoor piping during winter operations.

A simplified schematic diagram of the process is shown in Fig. G-1. The demilitarization process for each group of munitions is described below (Ref. G-12).

G.1.5.2. Projectiles and Mortars

These munitions (in ONCs) will be examined for leakers in the unloading area. Nonleaking munitions will be unloaded and transferred

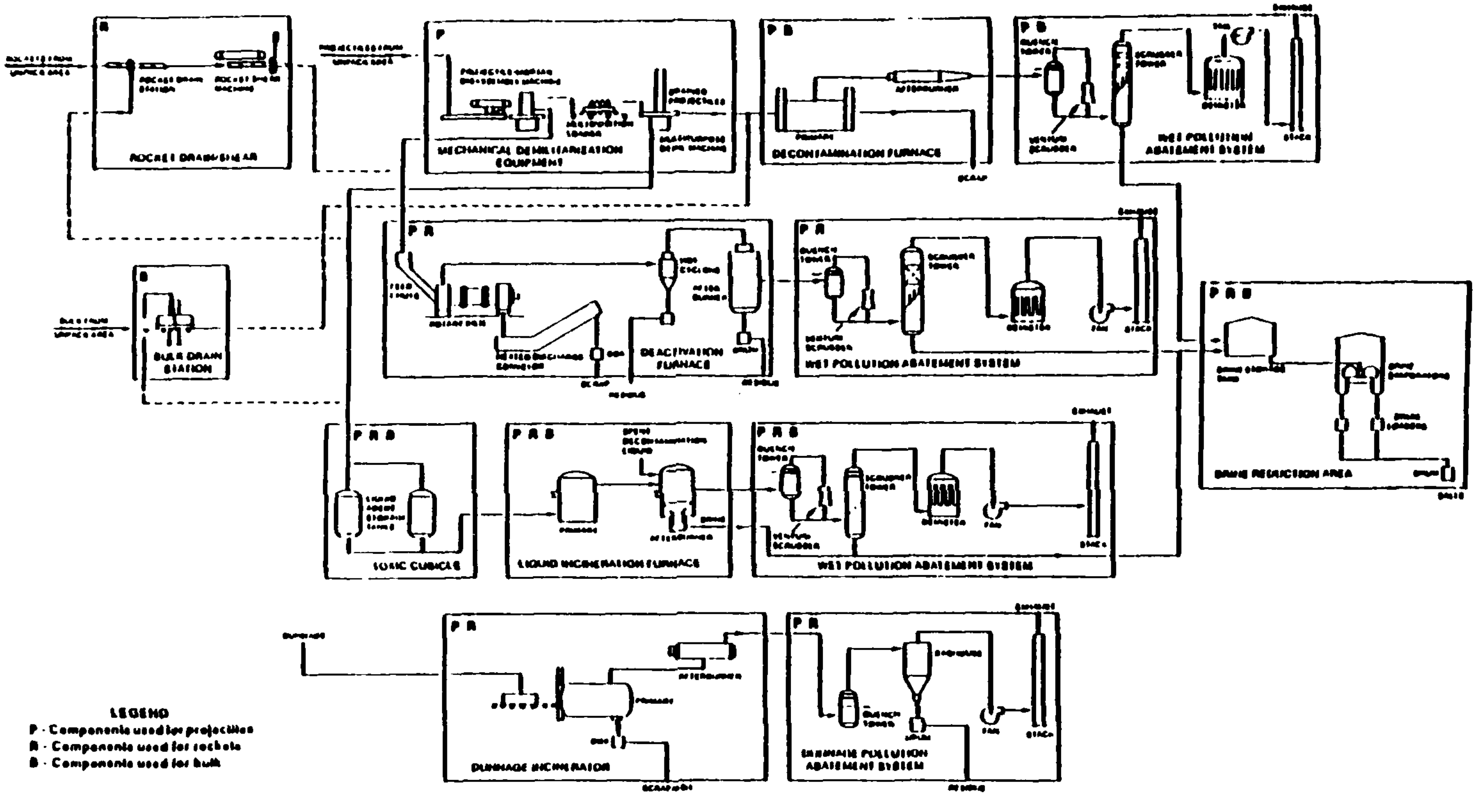


Fig. G-1. Munitions processing flow using JACADS design

by elevator to the UPA located on the second floor, where they will be removed from the pallets by personnel wearing Level D protective clothing. They will then be loaded manually on an input tray conveyor, taken to the explosive containment vestibule, and then moved through airlocks and blast gates to the explosive containment room (ECR). All dunnage resulting from the unpacking operation will be burned in the dunnage incinerator.

Inside the ECR, the projectile will be automatically placed on the projectile/mortar disassembly machine (PMD) turntable for removal of explosive components. The burster will then be conveyed to the burster size reduction machine (BSR) and fed by gravity through a discharge chute with double isolation valves into the deactivation furnace system (DFS). The fuze will be moved by conveyor to the DFS for incineration. The projectile will be probed to verify burster removal and placed on a conveyor from the ECR and leading to the multipurpose demilitarization machine (MDM) in the munitions processing bay. A pick-and-place robot will pick up a projectile from the pallet and place it on a rotating table. Here, the burster well will be extracted from the projectile and a tube will be inserted into the projectile to remove the liquid agent by suction and convey it to a storage tank in the toxic cubicle. If the burster well is stuck or welded in place, a milling station on the MDM rotating table will cut off the top of the burster well to allow its removal.

Agent collected in the TOX will be incinerated in a liquid incinerator (LIC). The drained projectiles will be placed on a tray and conveyed into the waiting munitions lift car, which descends to the first floor to transfer the tray to a charge car for introduction into the metal parts furnace (MPF). The MPF will thermally decontaminate the drained projectiles to a 5X level.*

---

*The 5X level of decontamination indicates that the material is free of contamination and can be handled without restriction.

G.1.5.3. Rockets

M55 rockets will arrive at the MDB in ONC containers. Only ONCs verified to be free of leaking rockets will be unloaded in the package unloading facility. Operators wearing Level D protective clothing will manually remove individual rockets, feed them through a munition metering system to the explosive containment vestibule (ECV), then into the ECR. The rockets will be automatically punched and drained at the rocket drain station (RDS) in the ECR. Agent will be drained from the rocket by pump suction and collected in the TOX for subsequent incineration in the LIC. Once drained of agent, the punched rockets will be conveyed to the rocket shear machine (RSM), which will shear the rockets into the required number of pieces. The separated sections fall by gravity into the feed chute leading to the DFS, which is located on the first floor of the MDB. An interlock will ensure that only one of the two blast gates in the feed chute is open at any given time.

If there are leaking rockets stored in an ONC, it will not be opened in the UPA, but will be conveyed directly to the ECV where operators wearing demilitarization protective ensemble (DPE) suits will open the ONC and manually unload each rocket onto the feed table feeding the conveyor. They will then be processed in the same way as nonleakers.

G.1.5.4. Mines

Pallets of nonleaking mine drums will be removed from the ONCs in the package unloading facility. Mine drums (three mines in a drum) will be unloaded from their pallet in the UPA and placed, unopened, on the drum conveyor entering a mine glove box (MIG) in the ECV. An operator wearing protective clothing will open the drum in the glove box and remove the mines. The activators and fuzes that have been packed in the drums will be placed in a cardboard container and conveyed to the DFS chute. The arming plug will also be removed. A mine will be conveyed into an ECR, where it will be automatically punched and drained of

agent. The agent will be drained from the mine by pump suction and pumped to the TOX for subsequent incineration in the LIC.

While in the ECR, the mine will be placed automatically in the mine machine (MIN) to punch out the booster. The mine body and booster are dropped into the DFS.

G.1.5.5. <u>Bulk Items</u>

Bombs, ton containers, and spray tanks in ONCs will be moved from the MHI by forklift and unpacked at the package unloading facility where an elevator will be used to transfer the munitions to the UPA which is located on the second floor of the JACADS plant. For the bulk only plants, the UPA will be located on the ground floor. A forklift will move the bulk item to the UPA for pallet removal and subsequent transfer to tray assemblies on the input conveyors. Spray tanks will be removed from their shipping containers in the UPA and transferred to tray assemblies on the input conveyor. Unpalletized bulk items, such as ton containers, will be placed directly on tray conveyors. The trays will be conveyed to the bulk drain station (BDS), which is equipped with a large punch and an agent pump and removal tube. The punch will produce a hole in the top of the bulk item, and the removal tube will be inserted through the hole to allow removal of the liquid agent, which will be transferred to the TOX by agent pipe lines.

The tray containing the drained bulk item will be transported to the munitions lift car, which descends to the first floor to discharge the tray to the buffer storage conveyor and into the MPF. Residual agent will be burned in the MPF.

G.1.6. DECOMMISSIONING

After the existing stockpile of lethal chemical agent and munitions at each site has been destroyed, the demilitarization facility will be decommissioned. The activities for cleanup and closure of the destruction facilities, as discussed in Chemical Stockpile Disposal Plan (Ref. G-11), are as follows:

1. Decontamination of the MDB and laboratory.
2. Disposal of all solid wastes and residues.
3. Certification of the plant and site as nontoxic.

The first step in the cleanup operation will be the removal of all equipment not required for the decommissioning effort from the noncontaminated areas of the facility. The contaminated portions of the building and the contaminated destruction equipment will be washed with an aqueous decontamination solution. When the washing operations are complete and the level of decon verified, the surrounding areas will be tested and monitored to verify that any vapor concentrations of agent are within allowable limits. The equipment will be disassembled for thermal decontamination. The building itself will be tested or monitored to verify that any vapor concentrations are within allowable limits.

The furnaces used for decontamination of the munitions will be maintained in place and used for the decontamination of process equipment as long as possible. Final decontamination of the remaining furnace and supporting equipment could be accomplished in a transportable furnace brought to the site.

After all necessary decontamination, disassembly, and demolition, all solid waste and residue resulting from the decommissioning will be disposed of. Materials that cannot be certified for other uses will be disposed of at approved hazardous waste landfill sites. The decontami-

nated plant and site will be monitored and tested to ensure that no residual toxic agent is present. After monitoring has been completed and monitoring samples satisfactorily analyzed, the plant will be certified closed.

G.1.7. REFERENCES

G-1. "Safety Manual," Department of the Army, AMC-R 385-100, August 1985.

G-2. "Safety Regulations for Chemical Agents GB and VX," Department of the Army, DARCOM-R 385-102, May 1982.

G-3. "Safety Regulations for Chemical Agents H, HD, and HT," Department of the Army, DARCOM-R 385-31, April 1979.

G-4. Science Applications International Corporation, "Probabilities of Selected Hazards in Disposition of M55 Rockets," U.S. Army Toxic and Hazardous Materials Agency, M55-CS-2, November 1985.

G-5. "Risk Analysis of the Continued Storage of Chemical Munitions," GA Technologies Inc., GA-C18564, December 1986.

G-6. "Toxic Munitions and Bulk Storage GB, VX, H, HT, HD: Surveillance and Leakage Test Procedures Ammunition Surveillance and Safety-In-Storage Procedures," Department of the Army, SB 742-1300-94-1, June 1972.

G-7. "Ammunition Surveillance Procedures (Draft)," Department of the Army, SB 742-1, November 1985.

G-8. Rhyne, W. R., et al., "Probabilistic Analysis of Chemical Agent Release During Transport of M55 Rockets," H&R 255-1, H&R Technical Associates, Inc., September 1985.

G-9. "Research and Development Services for Mechanical Process Development/Laboratory Studies in Support of the Munition/Agent Process Development Program," Volume 1, Book 2, GA Technologies Inc., GA-A16891, November 1982.

G-10. The R. M. Parsons Company, "JACADS Final Design Description," Task E-2, March 1985.

G-11. "Chemical Stockpile Disposal Plan," U.S. Army Toxic and Hazardous Materials Agency, Draft Report, AMXTH-CD-FR-85047, March 1986.

G-12. The R. M. Parsons Company, "JACADS Final Design Analysis Narrative (Sections 2 and 3)," April 1985.

APPENDIX H

(Classified Information)

APPENDIX I
TABULATED ACCIDENT SEQUENCE RESULTS

I.1. TABULATED ACCIDENT SEQUENCE RESULTS

The following subsections give the accident sequence results for long term storage, interim storage, handling, plant operations, onsite transport, and offsite transport of munitions.

I.1.1. LONG TERM STORAGE

The following tables list the accident results for long term storage for munitions at existing sites.

File: CONSTOR.WK1 date21-Aug-87 page 1

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

		Accident Frequencies																	Agent Available and Released				
SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SL1 - Munition develops a leak during the between-inspections period.																						
SLBGC	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	7.5E-05	1.0E+01	4.5E-04	1.0E+01	1.49E+05	-	-	4.80E+01	90 DAY
SLDHC	1	2.8E-07	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.0E-06	1.0E+01	7.0E-06	1.0E+01	N/A	-	6.91E+04	-	-	4.90E+00	90 DAY
SLCGC	1	2.8E-07	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	7.0E-06	1.0E+01	N/A	-	1.46E+04	-	-	1.60E+00	11 DAY
SLCHC	1	2.8E-07	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.0E-06	1.0E+01	N/A	-	N/A	-	2.92E+04	-	-	3.00E+00	90 DAY
SLKGC (IGL)	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.9E-04	1.0E+01	N/A	-	2.07E+05	-	-	9.00E+01	90 DAY
SLKHC (60' IGL)	1	5.9E-06	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.46E+05	-	-	2.13E+01	90 DAY
SLKHS (OPEN)	1	N/A	-	N/A	-	N/A	-	N/A	-	5.9E-06	1.0E+01	N/A	-	5.9E-06	1.0E+01	N/A	-	CLASS.	9.00E+01	-	-	90 DAY
SLKHS (OPEN)	1	N/A	-	5.9E-06	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	CLASS.	1.00E+00	-	-	1 DAY
SLKHC (WH)	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.9E-06	1.0E+01	5.39E+06	-	-	2.13E+01	90 DAY
SLKVC (80' IGL)	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.9E-06	1.0E+01	N/A	-	2.21E+05	-	-	1.82E-01	90 DAY
SLKVC (WH)	1	N/A	-	N/A	-	N/A	-	5.9E-06	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	-	-	1.82E-01	90 DAY
SLMVC	1	9.0E-06	1.0E+01	N/A	-	N/A	-	N/A	-	1.1E-06	1.0E+01	N/A	-	2.5E-04	1.0E+01	3.1E-04	1.0E+01	3.86E+04	-	-	NEGL	90 DAY
SLPGC	1	4.9E-06	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	8.1E-05	1.0E+01	6.2E-05	1.0E+01	6.72E+04	-	-	NEGL	90 DAY
SLPHC	1	4.9E-06	1.0E+01	N/A	-	9.3E-06	1.0E+01	N/A	-	N/A	-	5.0E-06	1.0E+01	8.1E-05	1.0E+01	N/A	-	1.21E+05	-	-	NEGL	90 DAY
SLPVC	1	4.9E-06	1.0E+01	N/A	-	9.3E-06	1.0E+01	N/A	-	N/A	-	N/A	-	8.1E-05	1.0E+01	6.2E-05	1.0E+01	6.20E+04	-	-	NEGL	90 DAY
SLQGC	1	4.9E-06	1.0E+01	N/A	-	9.3E-06	1.0E+01	N/A	-	N/A	-	N/A	-	8.1E-05	1.0E+01	6.2E-05	1.0E+01	6.00E+04	-	-	NEGL	90 DAY
SLQVC	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	8.1E-05	1.0E+01	6.2E-05	1.0E+01	6.00E+04	-	-	NEGL	90 DAY
SLRGC	1	6.1E-05	1.0E+01	N/A	-	4.3E-05	1.0E+01	N/A	-	9.1E-07	1.0E+01	N/A	-	1.3E-03	1.0E+01	1.8E-04	1.0E+01	4.04E+04	-	-	1.07E+01	71 DAY
SLRVC	1	6.1E-05	1.0E+01	N/A	-	4.3E-05	1.0E+01	N/A	-	9.1E-07	1.0E+01	N/A	-	1.3E-03	1.0E+01	1.8E-04	1.0E+01	3.78E+04	-	-	2.70E-02	90 DAY
SLSVC	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-05	1.0E+01	1.36E+04	-	-	NEGL	90 DAY
SLSVC (WH)	1	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-05	1.0E+01	N/A	-	1.83E+05	-	-	NEGL	90 DAY
SL2 - Munition punctured by forklift tine during leaker handling activities.																						
SLBGC	2	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.2E-06	1.3E+01	5.2E-06	1.3E+01	4.40E+02	-	-	4.26E+00	1 HR
SLDHC	2	4.4E-05	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	4.4E-05	1.3E+01	4.4E-05	1.3E+01	N/A	-	2.88E+02	-	-	1.30E-03	1 HR
SLCGC	2	1.1E-05	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-05	1.3E+01	N/A	-	4.80E+01	-	-	1.09E-01	1 HR
SLCHC	2	1.1E-05	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-05	1.3E+01	N/A	-	N/A	-	9.60E+01		-	1.30E-03	1 HR
SLKGC	2	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-					

See notes at end of table.

File: CONSTOK.WK1 date21-Aug-87 page 2

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies — Agent Available and Released

SCENARIO	NO.	AMAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLKHC	2	0.0E+00	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	0.0E+00	-	0.0E+00	-					
SLKVC	2	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	N/A	-					
SLMVC	2	8.5E-05	1.3E+01	N/A	-	N/A	-	N/A	-	8.5E-05	1.3E+01	N/A	-	8.5E-05	1.3E+01	8.5E-05	1.3E+01	0.00E+00	-	-	8.50E-06	1 HR
SLPGC	2	6.0E-05	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.0E-05	1.3E+01	6.0E-05	1.3E+01	5.20E+01	-	-	2.80E-01	1 HR
SLPHC	2	6.0E-05	1.3E+01	N/A	-	6.0E-05	1.3E+01	N/A	-	N/A	-	6.0E-05	1.3E+01	6.0E-05	1.3E+01	N/A	-	9.36E+01	-	-	1.05E-03	1 HR
SLPVC	2	6.0E-05	1.3E+01	N/A	-	6.0E-05	1.3E+01	N/A	-	N/A	-	N/A	-	6.0E-05	1.3E+01	6.0E-05	1.3E+01	4.80E+01	-	-	1.05E-05	1 HR
SLQGC	2	6.0E-05	1.3E+01	N/A	-	6.0E-05	1.3E+01	N/A	-	N/A	-	N/A	-	6.0E-05	1.3E+01	6.0E-05	1.3E+01	8.70E+01	-	-	2.80E-01	1 HR
SLQVC	2	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.0E-05	1.3E+01	6.0E-05	1.3E+01	8.70E+01	-	-	1.05E-05	1 HR
SLRGC	2	3.2E-04	1.3E+01	N/A	-	3.2E-04	1.3E+01	N/A	-	3.2E-04	1.3E+01	N/A	-	3.2E-04	1.3E+01	3.2E-04	1.3E+01	1.60E+02	-	-	4.46E-01	1 HR
SLRVC	2	3.2E-04	1.3E+01	N/A	-	3.2E-04	1.3E+01	N/A	-	3.2E-04	1.3E+01	N/A	-	3.2E-04	1.3E+01	3.2E-04	1.3E+01	1.50E+02	-	-	1.60E-05	1 HR
SLSVC	2	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.6E-06	1.3E+01	4.6E-06	1.3E+01	1.36E+03	-	-	1.35E-04	1 HR
SL4 - Large aircraft direct crash onto storage area; fire not contained in 30 minutes (burstered munitions detonate if hit).																						
SLBGF (80' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01	1.19E+05	-	-	1.19E+04	1HR
SLBGF (89' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-	1.49E+05	-	-	1.49E+04	1HR
SLDHC (60 IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.57E+04	-	8.93E+03	1.34E+03	20 MIN
SLDHC (80 IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-09	1.0E+01	9.8E-12	1.0E+01	N/A	-	4.95E+04	-	1.24E+04	1.86E+03	20 MIN
SLDHC (89 IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-	6.91E+04	-	1.73E+04	2.59E+03	20 MIN
SLCGC (60 IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	7.20E+03	-	1.80E+03	5.40E+02	20 MIN
SLCGC (80 IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	-	N/A	-	9.79E+03	-	2.45E+03	7.34E+02	20 MIN
SLCGC (89 IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-11	-	N/A	-	1.46E+04	-	3.65E+03	1.09E+03	20 MIN
SLCHC (60 IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	- -	1.44E+04	-	3.60E+03	5.40E+02	20 MIN
SLCHC (80 IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-09	1.0E+01	N/A	1.0E+01	N/A	-	1.96E+04	-	4.90E+03	7.34E+02	20 MIN
SLCHC (89 IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	1.0E+01	N/A	-	2.92E+04	-	7.30E+03	1.09E+03	20 MIN
SLKGF (80' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	N/A	-	2.07E+05	-	-	2.07E+04	1HR
SLKHF (60' IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.46E+05	-	-	7.31E+03	1HR
SLKHF (OPEN)	4	N/A	-	1.1E-09	1.0E+01	N/A	-	N/A	-	7.6E-09	1.0E+01	N/A	-	3.5E-09	1.0E+01	N/A	-	CLASS.	-	-	6.80E+04	1HR
SLKHF (MH)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-08	1.0E+01	5.39E+06	-	-	2.69E+05	1HR
SLKVF (80' IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	N/A	-	2.21E+05	-	-	5.52E+03	1HR

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 3

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

SCENARIO	NO.	Accident Frequencies ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	Agent Available and Released AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLBVF (WH)	4	N/A	-	N/A	-	N/A	-	1.6E-09	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	-	-	7.46E+04	1HR
SLMVC (60 IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.72E+04	-	6.80E+03	5.10E+02	20 MIN
SLMVC (80 IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	4.1E-11	1.0E+01	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01	3.86E+04	-	9.64E+03	7.23E+02	20 MIN
SLPGC (60 IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.59E+04	-	8.97E+03	2.69E+03	20 MIN
SLPGC (80 IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01	5.02E+04	-	1.26E+04	3.77E+03	20 MIN
SLPGC (89 IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-	6.72E+04	-	1.68E+04	5.04E+03	20 MIN
SLPHC (60 IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.46E+04	-	1.61E+04	2.42E+03	20 MIN
SLPHC (80 IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-09	1.0E+01	9.8E-12	1.0E+01	N/A	-	9.04E+04	-	2.26E+04	3.39E+03	20 MIN
SLPHC (89 IGL)	4	N/A	-	N/A	-	1.3E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-	1.21E+05	-	3.02E+04	4.53E+03	20 MIN
SLPVC (60 IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.31E+04	-	8.28E+03	6.21E+02	20 MIN
SLPVC (80 IGL)	4	2.2E 10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01	4.64E+04	-	1.16E+04	8.69E+02	20 MIN
SLPVC (89 IGL)	4	N/A	-	N/A	-	1.3E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-	6.20E+04	-	1.55E+04	1.16E+03	20 MIN
SLQGC (60 IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.29E+04	-	8.22E+03	2.47E+03	20 MIN
SLQGC (80 IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01	4.59E+04	-	1.15E+04	3.45E+03	20 MIN
SLQGC (89 IGL)	4	N/A	-	N/A	-	1.3E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-	6.00E+04	-	1.50E+04	4.50E+03	20 MIN
SLQVC (60 IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.29E+04	-	8.22E+03	6.17E+02	20 MIN
SLQVC (80 IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01	4.59E+04	-	1.15E+04	8.61E+02	20 MIN
SLQVC (89 IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-	6.00E+04	-	1.50E+04	1.13E+03	20 MIN
SLRGC (60 IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.12E+04	-	5.30E+03	1.59E+03	20 MIN
SLRGC (80 IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	4.1E-11	1.0E+01	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01	2.82E+04	-	7.06E+03	2.12E+03	20 MIN
SLRGC (89 IGL)	4	N/A	-	N/A	-	1.3E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-	4.04E+04	-	1.01E+04	3.03E+03	20 MIN
SLRVC (60 IGL)	4	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.98E+04	-	4.95E+03	3.71E+02	20 MIN
SLRVC (80 IGL)	4	2.2E-10	1.0E+01	N/A	-	N/A	-	N/A	-	4.1E-11	1.0E+01	N/A	-	9.8E-12	1.0E+01	4.1E-10	1.0E+01	2.64E+04	-	6.60E+03	4.95E+02	20 MIN
SLRVC (89 IGL)	4	N/A	-	N/A	-	1.3E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.0E+01	N/A	-	3.78E+04	-	9.45E+03	7.09E+02	20 MIN
SLSVF (80 IGL)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.1E-10	1.0E+01	1.36E+04	-	-	3.39E+02	1HR
SLSVF (WH)	4	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.9E-10	1.0E+01	N/A	-	1.83E+05	-	-	4.58E+03	1HR
SL5 - Large aircraft indirect crash onto storage area; fire not contained in 30 minutes (burstered munitions detonate if hit).																						
SLBGF (80 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01	1.19E+05	-	-	1.19E+04	1HR

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 4

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
		Accident Frequencies																Agent Available and Released				
SLBGF (89' IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-	1.49E+05	-	-	1.49E+04	1HR
SLDHC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.57E+04	-	8.93E+03	1.34E+03	20 MIN
SLDHC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	4.4E-10	1.3E+01	2.7E-12	1.3E+01	N/A	-	4.95E+04	-	1.24E+04	1.86E+03	20 MIN
SLDHC (89 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-	6.91E+04	-	1.73E+04	2.59E+03	20 MIN
SLCGC (60' IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	7.20E+03	-	1.80E+03	5.40E+02	20 MIN
SLCGC (80' IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	-	N/A	-	9.79E+03	-	2.45E+03	7.34E+02	20 MIN
SLCGC (89' IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	-	N/A	-	1.46E+04	-	3.65E+03	1.09E+03	20 MIN
SLCHC (60' IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.44E+04	-	3.60E+03	5.40E+02	20 MIN
SLCHC (80' IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	4.4E-10	1.3E+01	N/A	1.3E+01	N/A	-	1.96E+04	-	4.90E+03	7.34E+02	20 MIN
SLCHC (89 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	1.3E+01	N/A	-	2.92E+04	-	7.30E+03	1.09E+03	20 MIN
SLKGF (80 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-	2.07E+05	-	-	2.07E+04	1HR
SLKNF (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.46E+05	-	-	7.31E+03	1HR
SLKNF (OPEN)	5	N/A	-	2.1E-09	1.0E+01	N/A	-	N/A	-	7.9E-09	1.0E+01	N/A	-	2.7E-12	1.0E+01	N/A	-	CLASS.	-	-	6.80E+04	1HR
SLKNF (WH)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.4E-08	1.1E+01	5.39E+06	-	-	2.69E+05	1HR
SLKVF (80' IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-	2.21E+05	-	-	5.52E+03	1HR
SLKVF (WH)	5	N/A	-	N/A	-	N/A		3.8E-09	1.1E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	-	-	7.46E+04	1HR
SLMVC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.72E+04	-	6.80E+03	5.10E+02	20 MIN
SLMVC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.3E+01	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01	3.86E+04	-	9.64E+03	7.23E+02	20 MIN
SLPGC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.59E+04	-	8.97E+03	2.69E+03	20 MIN
SLPGC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01	5.02E+04	-	1.26E+04	3.77E+03	20 MIN
SLPGC (89 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	- -	6.72E+04	-	1.68E+04	5.04E+03	20 MIN
SLPHC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.46E+04	-	1.61E+04	2.42E+03	20 MIN
SLPHC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	4.4E-10	1.3E+01	2.7E-12	1.3E+01	N/A	-	9.04E+04	-	2.26E+04	3.39E+03	20 MIN
SLPHC (89 IGL)	5	N/A	-	N/A	-	3.4E-11	1.3E+01	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-	1.21E+05	-	3.02E+04	4.53E+03	20 MIN
SLPVC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.31E+04	-	8.28E+03	6.21E+02	20 MIN
SLPVC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01	4.64E+04	-	1.16E+04	8.69E+02	20 MIN
SLPVC (89 IGL)	5	N/A	-	N/A	-	3.4E-11	1.3E+01	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-	6.20E+04	-	1.55E+04	1.16E+03	20 MIN
SLQGC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.29E+04	-	8.22E+03	2.47E+03	20 MIN

See notes at end of table.

File: COMSTOR.WK1 date21-Aug-87 page 5

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

		Accident Frequencies																Agent Available and Released				
SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLQGC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01	4.59E+04	-	1.15E+04	3.45E+03	20 MIN
SLQGC (89 IGL)	5	N/A	-	N/A	-	3.4E-11	1.3E+01	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-	6.00E+04	-	1.50E+04	4.50E+03	20 MIN
SLQVC (60 IGL)	5	N/A		N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.29E+04	-	8.22E+03	6.17E+02	20 MIN
SLQVC (80 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01	4.59E+04	-	1.15E+04	8.61E+02	20 MIN
SLQVC (89 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-	6.00E+04	-	1.50E+04	1.13E+03	20 MIN
SLRGC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.12E+04	-	5.30E+03	1.59E+03	20 MIN
SLRGC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.3E+01	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01	2.82E+04	-	7.06E+03	2.12E+03	20 MIN
SLRGC (89 IGL)	5	N/A		N/A	-	3.4E-11	1.3E+01	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-	4.04E+04	-	1.01E+04	3.03E+03	20 MIN
SLRVC (60 IGL)	5	5.7E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.98E+04	-	4.95E+03	3.71E+02	20 MIN
SLRVC (80 IGL)	5	5.9E-11	1.3E+01	N/A	-	N/A	-	N/A	-	1.1E-11	1.3E+01	N/A	-	2.7E-12	1.3E+01	1.1E-10	1.3E+01	2.64E+04	-	6.60E+03	4.95E+02	20 MIN
SLRVC (89 IGL)	5	N/A	-	N/A	-	3.4E-11	1.3E+01	N/A	-	N/A	-	N/A	-	2.7E-12	1.3E+01	N/A	-	3.78E+04	-	9.45E+03	7.09E+02	20 MIN
SLSVF (80 IGL)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-10	1.3E+01	1.36E+04	-	-	3.39E+02	1HR
SLSVF (WH)	5	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.0E-10	1.1E+01	N/A	-	1.83E+05	-	-	4.58E+03	1HR
SL6 - Tornado generated missiles strike the storage magazine, warehouse, or open storage area; munitions breached (no detonation).																						
SL6GC	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.5E-15	9.4E+01	1.2E-15	9.4E+01	4.40E+02	-	-	2.56E+01	6 HR
SLDHC	6	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-13	9.4E+01	5.8E-15	9.4E+01	N/A	-	2.88E+02	-	-	1.30E-02	6 HR
SLCGC	6	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.8E-15	9.4E+01	N/A	-	4.80E+01	-	-	1.09E+00	6 HR
SLCHC	6	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-13	9.4E+01	N/A	-	N/A	-	9.60E+01	-	-	1.30E-02	6 HR
SLKGC (80 IGL)	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.4E-15	9.4E+01	N/A	-	1.50E+03	-	-	3.71E+01	6 HR
SLKHC (60 IGL)	6	1.2E-12	9.4E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.70E+03	-	-	1.44E-01	6 HR
SLKHS (OPEN)	6	N/A	-	6.6E-11	9.4E+01	N/A	-	N/A	-	9.9E-10	9.4E+01	N/A	-	1.2E-12	9.4E+01	N/A	- -	1.70E+03	1.70E+03	-	-	6 HR
SLKHC (WH)	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.9E-13	9.4E+01	1.70E+03	-	-	1.44E-01	6 HR
SLKVC (80 IGL)	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.4E-15	9.4E+01	N/A	-	1.60E+03	-	-	1.60E-03	6 HR
SLKVC (WH)	6	N/A	-	N/A	-	N/A	-	3.3E-10	9.4E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.60E+03	-	-	1.60E-03	6 HR
SLMVC	6	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	8.3E-12	9.4E+01	N/A	-	1.3E-14	9.4E+01	5.8E-15	9.4E+01	3.86E+04	-	-	2.30E-04	6 HR
SLPGC	6	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.8E-15	9.4E+01	5.8E-15	9.4E+01	6.72E+04	-	-	5.60E+00	6 HR
SLPHC	6	4.8E-12	9.4E+01	N/A	-	4.8E-12	9.4E+01	N/A	-	N/A	-	3.2E-13	9.4E+01	5.8E-15	9.4E+01	N/A	-	1.21E+05	-	-	2.20E-02	6 HR
SLPVC	6	4.8E-12	9.4E+01	N/A	-	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	5.8E-15	9.4E+01	5.8E-15	9.4E+01	6.20E+04	-	-	2.20E-04	6 HR

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 6

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

		Accident Frequencies																Agent Available and Released				
SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLQGC	6	4.8E-12	9.4E+01	N/A	-	4.8E-12	9.4E+01	N/A	-	N/A	-	N/A	-	5.8E-15	9.4E+01	5.8E-15	9.4E+01	6.00E+04	-	-	5.60E+00	6 HR
SLQVC	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.8E-15	9.4E+01	5.8E-15	9.4E+01	6.00E+04	-	-	2.20E-04	6 HR
SLRGC	6	4.8E-12	9.4E+01	N/A	-	4.8E-12	9.4E+01	N/A	-	1.9E-11	9.4E+01	N/A	-	4.8E-14	9.4E+01	5.8E-15	9.4E+01	4.04E+04	-	-	7.53E+00	6 HR
SLRVC	6	4.8E-12	9.4E+01	N/A	-	4.8E-12	9.4E+01	N/A	-	1.9E-11	9.4E+01	N/A	-	4.8E-14	9.4E+01	5.8E-15	9.4E+01	3.78E+04	-	-	2.80E-04	6 HR
SLSVC (80' IGL)	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.5E-15	9.4E+01	1.36E+04	-	-	1.60E-03	6 HR
SLSVC (WH)	6	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-13	9.4E+01	N/A	-	1.83E+05	-	-	1.60E-03	6 HR
SL7 - Severe earthquake breaches the munitions in storage igloo; no detonations.																						
SLDGC	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-06	1.3E+01	7.0E-08	1.3E+01	1.49E+05	-	-	2.56E+01	6 HR
SLDHC	7	3.0E-08	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	3.0E-08	1.3E+01	7.0E-07	1.3E+01	N/A	-	6.91E+04	-	-	7.80E-03	6 HR
SLCGC	7	7.0E 09	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-07	1.3E+01	N/A	-	1.46E+04	-	-	6.53E-01	6 HR
SLCHC	7	7.0E-09	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	7.0E-09	1.3E+01	N/A	-	N/A	-	2.92E+04	-	-	2.07E-03	6 HR
SLKGC (80' IGL)	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-05	1.3E+01	N/A	-	2.07E+05	-	-	3.71E+01	6 HR
SLKHC (60' IGL)	7	4.6E-07	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.46E+05	-	-	1.44E-01	6 HR
SLKHS (OPEN)	7	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	CLASS.	-	-	-	-
SLKHC (WH)	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.39E+06	-	-	-	-
SLKVC (80' IGL)	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-05	1.3E+01	N/A	-	2.21E+05	-	-	1.60E-03	6 HR
SLKVC (WH)	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	-	-	-	-
SLMVC	7	1.8E-08	1.3E+01	N/A	-	N/A	-	N/A	-	1.8E-08	1.3E+01	N/A	-	4.1E-07	1.3E+01	1.8E-08	1.3E+01	3.86E+04	-	-	1.00E-04	6 HR
SLPGC	7	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	6.72E+04	-	-	-	-
SLPHC	7	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	N/A	-	1.21E+05	-	-	-	-
SLPVC	7	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	- -	6.20E+04	-	-	-	-
SLQGC	7	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	6.00E+04	-	-	-	-
SLQVC	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	6.00E+04	-	-	-	-
SLRGC	7	9.7E-08	1.3E+01	N/A	-	9.7E-08	1.3E+01	N/A	-	9.7E-08	1.3E+01	N/A	-	2.1E-06	1.3E+01	9.7E-08	1.3E+01	4.04E+04	-	-	2.68E+00	6 HR
SLRVC	7	9.7E-08	1.3E+01	N/A	-	9.7E-08	1.3E+01	N/A	-	9.7E-08	1.3E+01	N/A	-	2.1E-06	1.3E+01	9.7E-08	1.3E+01	3.78E+04	-	-	1.00E-04	6 HR
SLSVC (80' IGL)	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	1.36E+04	-	-	-	-
SLSVC (WH)	7	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.83E+05	-	-	-	-
SL8 - Meteorite strikes the storage area; fire occurs; munitions breached (if burstered detonation occurs)																						

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 7

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

		Accident Frequencies																Agent Available and Released				
SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLBGF	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01	1.49E+05	-	-	1.49E+04	1 HR
SLBHC	8	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01	N/A	-	6.91E+04	-	1.73E+04	2.59E+03	20 MIN
SLCGC	8	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	N/A	-	1.46E+04	-	3.65E+03	1.09E+03	20 MIN
SLCHC	8	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	N/A	-	N/A	-	2.92E+04	-	7.30E+03	1.09E+03	20 MIN
SLKGF (IGL)	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	N/A	-	2.07E+05	-	-	2.07E+04	1 HR
SLKHF (IGL)	8	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.46E+05	-	-	7.31E+03	1 HR
SLKHF (OPEN)	8	N/A	-	1.2E-11	1.7E+01	N/A	-	N/A	-	1.2E-11	1.7E+01	N/A	-	1.2E-11	1.7E+01	N/A	-	CLASS.	-	-	6.80E+04	1 HR
SLKHF (HH)	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-10	2.6E+01	5.39E+06	-	-	2.69E+05	1 HR
SLKVF (IGL)	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	N/A	-	2.21E+05	-	-	5.52E+03	1 HR
SLKVF (HH)	8	N/A	-	N/A	-	N/A	-	1.0E-09	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	-	-	7.46E+04	1 HR
SLMVC	8	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01	3.86E+04	-	9.64E+03	7.23E+02	20 MIN
SLPGC	8	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01	6.72E+04	-	1.68E+04	5.04E+03	20 MIN
SLPHC	8	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01	N/A	-	1.21E+05	-	3.02E+04	4.53E+03	20 MIN
SLPVC	8	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01	6.20E+04	-	1.55E+04	1.16E+03	20 MIN
SLQGC	8	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01	6.00E+04	-	1.50E+04	4.50E+03	20 MIN
SLQVC	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01	6.00E+04	-	1.50E+04	1.13E+03	20 MIN
SLRGC	8	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01	4.04E+04	-	1.01E+04	3.03E+03	20 MIN
SLRVC	8	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	N/A	-	6.7E-12	2.6E+01	6.7E-12	2.6E+01	3.78E+04	-	9.45E+03	7.09E+02	20 MIN
SLSVF (IGL)	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.7E-12	2.6E+01	1.36E+04	-	-	3.39E+02	1 HR
SLSVF (HH)	8	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.7E-09	2.6E+01	N/A	-	1.83E+05	-	-	4.58E+03	1 HR
SL9 - Munition dropped during leaker isolation activities.																						
SLBGC	9	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.6E-07	1.3E+01	6.6E-07	1.3E+01	4.40E+02	-	-	4.26E+00	1 HR
SLBHC	9	4.5E-07	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	4.5E-07	1.3E+01	4.5E-07	1.3E+01	N/A	-	2.88E+02	-	-	1.30E-03	1 HR
SLCGC	9	9.8E-08	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-08	1.3E+01	N/A	-	4.80E+01	-	-	1.09E-01	1 HR
SLCHC	9	9.8E-08	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	9.8E-08	1.3E+01	N/A	-	N/A	-	9.60E+01	-	-	1.30E-03	1 HR
SLKGC	9	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.9E-07	1.3E+01	N/A	-	1.50E+03	-	-	6.40E+00	1 HR
SLKHC	9	1.9E-07	1.3E+01	1.9E-07	1.3E+01	N/A	-	N/A	-	1.9E-07	1.3E+01	N/A	-	1.9E-07	1.3E+01	1.9E-07	1.3E+01	1.70E+03	-	-	2.50E-02	1 HR
SLKVC	9	N/A	-	N/A	-	N/A	-	1.9E-07	1.3E+01	N/A	-	N/A	-	1.9E-07	1.3E+01	N/A	-	1.60E+03	-	-	2.70E-04	1 HR

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 8

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

Accident Frequencies | Agent Available and Released

SCENARIO	NO.	AMAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLMVC	9	3.6E-07	1.3E+01	N/A	-	N/A	-	N/A	-	3.6E-07	1.3E+01	N/A	-	3.6E-07	1.3E+01	3.6E-07	1.3E+01	3.70E+02	-	-	1.70E-05	1 %
SLPGC	9	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	5.20E+01	-	.	-	-
SLPMC	9	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	N/A	-	9.36E+01	-	.		-
SLPVC	9	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	6.80E+01	-	.		-
SLQGC	9	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	8.70E+01	-	.		-
SLQVC	9	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	8.70E+01	-	-		-
SLRGC	9	1.5E-06	1.3E+01	N/A	-	1.5E-06	1.3E+01	N/A	-	1.5E-06	1.3E+01	N/A	-	1.5E-06	1.3E+01	1.5E-06	1.3E+01	1.60E+02	-	-	4.46E-01	1 HR
SLRVC	9	1.5E-06	1.3E+01	N/A	-	1.5E-06	1.3E+01	N/A	-	1.5E-06	1.3E+01	N/A	-	1.5E-06	1.3E+01	1.5E-06	1.3E+01	1.50E+02	-		1 60E-05	1 HR
SLSVC	9	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.6E-06	1.3E+01	3.6E-06	1.3E+01	1.36E+03	-		2 70E-04	1 HR
SL15 - Small aircraft direct crash onto warehouse or open storage yard; fire not contained in 30 minutes.																						
SLKGF (IGL)	15	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	2.07E+05	-		.	-
SLKMF (IGL)	15	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.46E+05	-	-	.	-
SLKMF (OPEN)	15	N/A	-	1.6E-05	1.0E+01	N/A	-	N/A	-	5.6E-07	1.0E+01	N/A	-	1.4E-07	1.0E+01	N/A	-	CLASS.	-	-	5.10E+03	30 MIN
SLKMF (WH)	15	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	8.9E-09	1.0E+01	5.39E+06	-	-	2.69E+05	30 MIN
SLKVF (IGL)	15	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	2.21E+05	-	-	-	-
SLKVF (WH)	15	N/A	-	N/A	-	N/A	-	8.1E-09	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	-	-	7.46E+04	30 MIN
SLSVF (IGL)	15	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.36E+04	-	-	-	-
SLSVF (WH)	15	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.6E-08	1.0E+01	N/A	-	1.83E+05	-	-	2.03E+03	30 MIN
SL16 - Large aircraft direct crash; no fire. (burstered munitions detonate)																						
SLBGC (80' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01	1.19E+05	-	.	5.12E+01	4 HR
SLBGC (89' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	.N/A	-	1.3E-11	1.0E+01	N/A	- -	1.49E+05	-	-	5.12E+01	4 HR
SLDMC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.57E+04	-	7.14E+02	2.00E-01	4 HR
SLDMC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.0E-09	1.0E+01	1.2E-11	1.0E+01	N/A	-	4.95E+04	-	9.91E+02	2.00E-01	4 HR
SLBMC (89' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-	6.91E+04	-	1.30E+03	2.00E-01	4 HR
SLCGC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	7.20E+03	-	1.40E+02	5.12E+01	4 HR
SLCGC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	[illegible].7E-11	-	N/A	-	9.79E+03	-	1.96E+02	5.12E+01	4 HR
SLCGC (89' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.3E-[illegible]	-	N/A	-	1.46E+04	-	2.92E+02	5.12E+01	4 HR
SLCMC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.44E+04	-	2.88E+02	2.00E-01	4 HR

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 9

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

		Accident Frequencies																Agent Available and Released				
SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLCHC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.0E-09	1.0E+01	N/A	1.0E+01	N/A	-	1.96E+04	-	3.92E+02	2.00E-01	4 HR
SLCHC (89' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	1.0E+01	N/A	-	2.92E+04	-	5.84E+02	2.00E-01	4 HR
SLKGC (80' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	N/A	-	2.07E+05	-	-	5.12E+01	4 HR
SLKHC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.46E+05	-	-	2.00E-01	4 HR
SLKHS (OPEN)	16	N/A	-	1.3E-09	1.0E+01	N/A	-	N/A	-	9.4E-09	1.0E+01	N/A	-	4.3E-09	1.0E+01	N/A	-	CLASS.	3.40E+05	-	-	4 HR
SLXHS (WH)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.4E-08	1.0E+01	5.39E+06	3.40E+05	-	-	4 HR
SLKVC (80' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	N/A	-	2.21E+05	-	-	2.16E-03	4 HR
SLKVS (WH)	16	N/A	-	N/A	-	N/A	-	2.0E-09	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	3.20E+05	-	-	4 HR
SLMVC (60 IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.72E+04	-	1.36E+03	2.16E-03	4 HR
SLMVC (80 IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	5.0E-11	1.0E+01	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01	3.86E+04	-	1.93E+03	2.16E-03	4 HR
SLPGC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.59E+04	-	7.18E+02	5.12E+01	4 HR
SLPGC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01	5.02E+04	-	1.00E+03	5.12E+01	4 HR
SLPGC (89' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-	6.72E+04	-	1.34E+03	5.12E+01	4 HR
SLPHC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.46E+04	-	1.29E+03	2.00E-01	4 HR
SLPHC (80 IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.0E-09	1.0E+01	1.2E-11	1.0E+01	N/A	-	9.04E+04	-	1.81E+03	2.00E-01	4 HR
SLPHC (89' IGL)	16	N/A	-	N/A	-	N/A	1.0E+01	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-	1.21E+05	-	2.42E+03	2.00E-01	4 HR
SLPVC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.31E+04	-	6.62E+02	2.16E-03	4 HR
SLPVC (80 IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01	4.64E+04	-	9.27E+02	2.16E-03	4 HR
SLPVC (89' IGL)	16	N/A	-	N/A	-	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-	6.20E+04	-	1.24E+03	2.16E-03	4 HR
SLQGC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.29E+04	-	6.58E+02	5.12E+01	4 HR
SLQGC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01	4.59E+04	-	9.19E+02	5.12E+01	4 HR
SLQGC (89' IGL)	16	N/A	-	N/A	-	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-	6.00E+04	-	1.20E+03	5.12E+01	4 HR
SLQVC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.29E+04	-	6.58E+02	2.16E-03	4 HR
SLQVC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01	4.59E+04	-	9.19E+02	2.16E-03	4 HR
SLQVC (89' IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-	6.00E+04	-	1.20E+03	2.16E-03	4 HR
SLRGC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.12E+04	-	1.06E+03	5.12E+01	4 HR
SLRGC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	5.0E-11	1.0E+01	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01	2.82E+04	-	1.41E+03	5.12E+01	4 HR
SLRGC (89' IGL)	16	N/A	-	N/A	-	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-	4.04E+04	-	2.02E+03	5.12E+01	4 HR

See notes at end of table.

File: COMSTOR.WK1 date21-Aug-87 page 10

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

		Accident Frequencies																Agent Available and Released				
SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLRVC (60' IGL)	16	2.0E-10	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.90E+04	-	9.90E+02	2.16E-03	4 HR
SLRVC (80' IGL)	16	2.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	5.0E-11	1.0E+01	N/A	-	1.2E-11	1.0E+01	5.0E-10	1.0E+01	2.64E+04	-	1.32E+03	2.16E-03	4 HR
SLRVC (89 IGL)	16	N/A	-	N/A	-	1.6E-10	1.0E+01	N/A	-	N/A	-	N/A	-	1.3E-11	1.0E+01	N/A	-	3.70E+04	-	1.89E+03	2.16E-03	4 HR
SLSVC (8G IGL)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	5.0E-10	1.0E+01	1.36E+04	-	-	2.16E-03	4 HR
SLSVS (WH)	16	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.0E-10	1.0E+01	N/A	-	1.83E+05	2.71E+05	-	-	4 HR
SL17 - large aircraft direct crash; fire contained within 30 minutes. (Applies to non-burstered munitions only)																						
SLKHF (OPEN)	17	N/A	-	3.7E-13	1.0E+01	N/A	-	N/A	-	2.6E-12	1.0E+01	N/A	-	1.2E-12	1.0E+01	N/A	-	CLASS.	-	-	1.70E+04	30 MIN
SLKHF (WH)	17	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.8E-12	1.0E+01	5.39E+06	-	-	1.70E+04	30 MIN
SLKVF (WH)	17	N/A	-	N/A	-	N/A	-	5.6E-13	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	-	-	8.00E+03	30 MIN
SLSVF (WH)	17	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.3E-13	1.0E+01	N/A	-	1.83E+05	-	-	6.78E+03	30 MIN
SL18 - Small aircraft direct crash onto warehouse or open storage yard; no fire.																						
SLKHS (OPEN)	18	N/A	-	2.0E-05	1.0E+01	N/A	-	N/A	-	6.9E-07	1.0E+01	N/A	-	1.7E-07	1.0E+01	N/A	-	CLASS.	2.55E+04	-	-	4 HR
SLKHS (WH)	18	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.1E-08	1.0E+01	5.39E+06	2.55E+04	-	-	4 HR
SLKVS (WH)	18	N/A	-	N/A	-	N/A	-	1.0E-08	1.0E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	2.40E+04	-	-	4 HR
SLSVS (WH)	18	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.9E-08	1.0E+01	N/A	-	1.83E+05	2.03E+04	-	-	4 HR
SL19 - Small aircraft direct crash onto warehouse or open storage yard; fire contained in 30 minutes.																						
SLKHF (OPEN)	19	N/A	-	3.0E-07	1.3E+01	N/A	-	N/A	-	1.1E-08	1.3E+01	N/A	-	2.7E-09	1.3E+01	N/A	-	CLASS.	-	-	1.28E+03	30 MIN
SLKHF (WH)	19	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.0E-10	1.3E+01	5.39E+06	-	-	1.28E+03	30 MIN
SLKVF (WH)	19	N/A	-	N/A	-	N/A	-	1.5E-10	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	-	-	6.00E+02	30 MIN
SLSVF (WH)	19	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.0E-10	1.3E+01	N/A	-	1.83E+05	-	-	5.09E+02	30 MIN
SL20 - Large aircraft indirect crash onto storage area; no fire.																						
SLBGC (80' IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01	1.19E+05	-	-	1.30E+02	4 HR
SLBGC (89 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-	1.49E+05	-	-	1.73E+02	4 HR
SLDHC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.57E+04	-	6.00E+00	3.10E-02	4 HR
SLDHC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	5.4E-10	1.3E+01	3.3E-12	1.3E+01	N/A	-	4.95E+04	-	6.00E+00	4.29E-02	4 HR
SLDHC (89' IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-	6.91E+04	-	6.00E+00	5.99E-02	4 HR
SLCGC (60' IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	7.20E+03	-	1.60E+00	1.96E+00	4 HR
SLCGC (80' IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	-	N/A	-	9.79E+03	-	1.60E+00	2.67E+00	4 HR

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 11

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

		Accident Frequencies																Agent Available and Released				
SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLCGC (89 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.4E-12	-	N/A	-	1.46E+04	-	1.60E+00	3.98E+00	4 HR
SLCHC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.44E+04	-	3.20E+00	2.34E-02	4 HR
SLCHC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	5.4E-10	1.3E+01	N/A	1.3E+01	N/A	-	1.96E+04	-	3.20E+00	3.18E-02	4 HR
SLCHC (89 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	1.3E+01	N/A	-	2.92E+04	-	3.20E+00	4.74E-02	4 HR
SLKGC (80 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	N/A	-	2.07E+05	-	-	5.30E+01	4 HR
SLKHC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.46E+05	-	-	1.29E-01	4 HR
SLXHS (OPEN)	20	N/A	-	2.6E-09	1.0E+01	N/A	-	N/A	-	9.7E-09	1.0E+01	N/A	-	3.5E-09	1.0E+01	N/A	-	CLASS.	6.80E+04	-	-	4 HR
SLXHC (WH)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.7E-08	1.1E+01	5.39E+06	-	-	2.00E+00	4 HR
SLKVC (80 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	N/A	-	2.21E+05	-	-	2.24E-03	4 HR
SLKVC (WH)	20	N/A	-	N/A	-	N/A	-	4.7E-09	1.1E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	-	-	2.16E-02	4 HR
SLMVC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.72E+04	-	1.05E+01	8.81E-04	4 HR
SLMVC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	1.4E-11	1.3E+01	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01	3.86E+04	-	1.05E+01	1.25E-03	4 HR
SLPGC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.59E+04	-	6.50E+00	1.24E+01	4 HR
SLPGC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01	5.02E+04	-	6.50E+00	1.73E+01	4 HR
SLPGC (89 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-	6.72E+04	-	6.50E+00	2.32E+01	4 HR
SLPHC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	6.46E+04	-	1.17E+01	4.64E-02	4 HR
SLPHC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	5.4E-10	1.3E+01	3.3E-12	1.3E+01	N/A	-	9.04E+04	-	1.17E+01	6.49E-02	4 HR
SLPHC (89 IGL)	20	N/A	-	N/A	-	4.2E-11	1.3E+01	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-	1.21E+05	-	1.17E+01	8.68E-02	4 HR
SLPVC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.31E+04	-	6.00E+00	4.64E-04	4 HR
SLPVC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01	4.64E+04	-	6.00E+00	6.49E-04	4 HR
SLPVC (89 IGL)	20	N/A	-	N/A	-	4.2E-11	1.3E+01	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	- -	6.20E+04	-	6.00E+00	8.68E-04	4 HR
SLQGC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.29E+04	-	1.45E+01	5.08E+00	4 HR
SLQGC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01	4.59E+04	-	1.45E+01	7.10E+00	4 HR
SLQGC (89 IGL)	20	N/A		N/A	-	4.2E-11	1.3E+01	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-	6.00E+04	-	1.45E+01	9.27E+00	4 HR
SLQVC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.29E+04	-	1.45E+01	1.91E-04	4 HR
SLQVC (80 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01	4.59E+04	-	1.45E+01	2.66E-04	4 HR
SLQVC (89 IGL)	20	N/A		N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-	6.00E+04	-	1.45E+01	3.48E-04	4 HR
SLRGC (60 IGL)	20	7.0E-11	1.3E+01	N/A		N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.12E+04	-	1.07E+01	1.77E+01	4 HR

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 12

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

		Accident Frequencies																	Agent Available and Released					
SCENARIO	NO.	AMAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLRGC (B0 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	1.4E-11	1.3E+01	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01	2.82E+04	-	1.07E+01	2.35E+01	4 HR
SLRGC (B9 IGL)	20	N/A	-	N/A	-	4.2E-11	1.3E+01	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-	4.04E+04	-	1.07E+01	3.37E+01	4 HR
SLRVC (60 IGL)	20	7.0E-11	1.3E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.98E+04	-	1.00E+01	6.34E-04	4 HR
SLRVC (B0 IGL)	20	7.3E-11	1.3E+01	N/A	-	N/A	-	N/A	-	1.4E-11	1.3E+01	N/A	-	3.3E-12	1.3E+01	1.4E-10	1.3E+01	2.64E+04	-	1.00E+01	8.45E-04	4 HR
SLRVC (B9 IGL)	20	N/A	-	N/A	-	4.2E-11	1.3E+01	N/A	-	N/A	-	N/A	-	3.4E-12	1.3E+01	N/A	-	3.78E+04	-	1.00E+01	1.21E-03	4 HR
SLSVC (B0 IGL)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.4E-10	1.3E+01	1.36E+04	-	-	1.62E-04	4 HR
SLSVC (NN)	20	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	7.4E-10	1.1E+01	N/A	-	1.83E+05	-	-	2.16E-02	4 HR
SL21 large aircraft indirect crash onto storage area; fire contained in 30 minutes																						
SLBGF (B0 IGL)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.2E-16	-	0.0E+00	-	1.19E+05	-	-	3.56E+02	30 MIN
SLBGF (B9 IGL)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.3E-16	-	N/A	-	1.49E+05	-	-	4.46E+02	30 MIN
SLKGF (B0 IGL)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.2E-16	-	N/A	-	2.07E+05	-	-	6.21E+02	30 MIN
SLKNF (60 IGL)	21	1.9E-14	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.46E+05	-	-	2.19E+02	30 MIN
SLKNF (OPEN)	21	N/A	-	7.2E-13	1.0E+01	N/A	-	N/A	-	2.7E-12	1.0E+01	N/A	-	9.7E-13	1.0E+01	N/A	-	CLASS.	-	-	6.80E+04	30 MIN
SLKNF (NN)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	4.8E-12	1.1E+01	5.39E+06	-	-	6.86E+04	30 MIN
SLKVF (B0 IGL)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	9.2E-16	1.3E+01	N/A	-	2.21E+05	-	-	1.66E+02	30 MIN
SLKVF (NN)	21	N/A	-	N/A	-	N/A	-	1.3E-12	1.1E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	-	-	1.20E+05	30 MIN
SLSVF (B0 IGL)	21	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	1.36E+04	-	-	1.02E+01	30 MIN
SLSVF (NN)	21	N/A		N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	2.1E-13	1.1E+01	N/A	-	1.83E+05	-	-	5.42E+04	30 MIN
SL22 - Severe earthquake leads to munition detonation																						
SLBGC	22	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	1.49E+05	-	-	-	-
SLDMC	22	1.2E-08	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.2E-08	2.6E+01	2.7E-07	2.6E+01	N/A	- -	6.91E+04	--	6.00E+00	6.50E-03	6 HR
SLCGC	22	6.2E-07	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.4E-07	2.6E+01	N/A	-	1.46E+04	--	1.60E+00	5.45E-01	6 HR
SLCMC	22	6.2E-07	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	6.2E-07	2.6E+01	N/A	-	N/A	-	2.92E+04	--	3.20E+00	6.50E-03	6 HR
SLKGS (IGL)	22	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	2.07E+05	--	-	-	-
SLKMS (IGL)	22	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.46E+05	--	-	-	-
SLKMS (OPEN)	22	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	CLASS.	--	-	-	-
SLKMS (NN)	22	N/A	-	N/A		N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	5.39E+06	--	-	-	-
SLKVS (IGL)	22	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	2.21E+05	--	-	-	-

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 13

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

		Accident Frequencies																Agent Available and Released				
SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLKVS (WH)	22	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	--	-	-	-
SLMVC	22	7.0E-09	2.6E+01	N/A	-	N/A		N/A	-	7.0E-09	2.6E+01	N/A	-	1.6E-07	2.6E+01	7.0E-09	2.6E+01	3.86E+04	--	3.15E+01	2.55E-04	6 HR
SLPGC	22	4.7E-09	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.0E-07	2.6E+01	4.7E-09	2.6E+01	6.72E+04	--	6.50E+00	2.80E+00	6 HR
SLPHC	22	4.7E-09	2.6E+01	N/A	-	4.7E-09	2.6E+01	N/A	-	N/A	-	4.7E-09	2.6E+01	1.0E-07	2.6E+01	N/A	-	1.21E+05	--	1.17E+01	1.05E-02	6 HR
SLPVC	22	4.7E-09	2.6E+01	N/A	-	4.7E-09	2.6E+01	N/A	-	N/A	-	N/A	-	1.0E-07	2.6E+01	4.7E-09	2.6E+01	6.20E+04	--	6.00E+00	1.05E-04	6 HR
SLQGC	22	3.4E-09	2.6E+01	N/A	-	3.4E-09	2.6E+01	N/A	-	N/A	-	N/A	-	7.6E-08	2.6E+01	3.4E-09	2.6E+01	6.00E+04	--	1.45E+01	2.80E+00	6 HR
SLQVC	22	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	7.6E-08	2.6E+01	3.4E-09	2.6E+01	6.00E+04	--	1.45E+01	1.05E-04	6 HR
SLRGC	22	3.9E-09	2.6E+01	N/A		3.9E-09	2.6E+01	N/A	-	3.9E-09	2.6E+01	N/A	-	8.9E-08	2.6E+01	3.9E-09	2.6E+01	4.04E+04	--	2.14E+01	5.80E+00	6 HR
SLRVC	22	3.9E-09	2.6E+01	N/A	-	3.9E-09	2.6E+01	N/A	-	3.9E-09	2.6E+01	N/A	-	8.9E-08	2.6E+01	3.9E-09	2.6E+01	3.78E+04	--	2.00E+01	2.08E-04	6 HR
SLSVF (IGL)	22	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	1.36E+04	-	-	-	-
SLSVF (WH)	22	N/A	-	N/A	-	N/A		N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	1.83E+05	-	-	-	-
SL23 - Tornado generated missiles strike the storage igloo and cause munition detonation.																						
SLBGS	23	N/A	-	N/A	-	N/A		N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	1.49E+05	-	-	-	-
SLDHC	23	3.4E-13	9.9E+01	N/A		N/A	-	N/A	-	N/A	-	2.2E-14	9.9E+01	3.2E-16	9.9E+01	N/A	-	6.91E+04	-	6.00E+00	6.50E-03	6 HR
SLCGC	23	3.4E-13	9.9E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-16	9.9E+01	N/A	-	1.46E+04	-	1.60E+00	5.45E-01	6 HR
SLCHC	23	3.4E-13	9.9E+01	N/A	-	N/A	-	N/A	-	N/A	-	2.2E-14	9.9E+01	N/A	-	N/A	-	2.92E+04	-	3.20E+00	6.50E-03	6 HR
SLKGS (IGL)	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	2.07E+05	-	-	-	-
SLKHS (IGL)	23	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	1.46E+05	-	-	-	-
SLKHS (OPEN)	23	N/A	-	0.0E+00		N/A	-	N/A		0.0E+00	-	N/A	-	0.0E+00	-	N/A	-	CLASS.	-	-	-	-
SLKHS (WH)	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	5.39E+06	-	-	-	-
SLKVS (IGL)	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	--	2.21E+05	-	-	-	-
SLKVS (WH)	23	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	2.99E+06	-	-	-	-
SLMVC	23	3.4E-13	9.9E+01	N/A	-	N/A	-	N/A	-	4.6E-13	9.9E+01	N/A	-	7.4E-16	9.9E+01	4.0E-16	9.9E+01	3.86E+04	-	3.15E+01	2.55E-04	6 HR
SLPGC	23	3.4E-13	9.9E+01	N/A	-	N/A		N/A	-	N/A	-	N/A	-	3.2E-16	9.9E+01	4.0E-16	9.9E+01	6.72E+04	-	6.50E+00	2.80E+00	6 HR
SLPHC	23	3.4E-13	9.9E+01	N/A	-	3.4E-13	9.9E+01	N/A	-	N/A	-	2.2E-14	9.9E+01	3.2E-16	9.9E+01	N/A	-	1.21E+05	-	1.17E+01	1.05E-02	6 HR
SLPVC	23	3.4E-13	9.9E+01	N/A	-	3.4E-13	9.9E+01	N/A	-	N/A	-	N/A	-	3.2E-16	9.9E+01	4.0E-16	9.9E+01	6.20E+04	-	6.00E+00	1.05E-04	6 HR
SLQGC	23	3.4E-13	9.9E+01	N/A	-	3.4E-13	9.9E+01	N/A	-	N/A	-	N/A	-	3.2E-16	9.9E+01	4.0E-16	9.9E+01	6.00E+04	-	1.45E+01	2.80E+00	6 HR
SLQVC	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-16	9.9E+01	4.0E-16	9.9E+01	6.00E+04	-	1.45E+01	1.05E-04	6 HR

See notes at end of table.

File: CONSTOR.WK1 date21-Aug-87 page 14

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

		Accident Frequencies																Agent Available and Released				
SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLRGC	23	3.4E-13	9.9E+01	N/A	-	3.4E-13	9.9E+01	N/A	-	1.1E-12	9.9E+01	N/A	-	2.6E-15	9.9E+01	4.0E-16	9.9E+01	4.04E+04	-	2.14E+01	5.80E+00	6 HR
SLRVC	23	3.4E-13	9.9E+01	N/A	-	3.4E-13	9.9E+01	N/A	-	1.1E-12	9.9E+01	N/A	-	2.6E-15	9.9E+01	4.0E-16	9.9E+01	3.78E+04	-	2.00E+01	2.08E-04	6 HR
SLSVS (IGL)	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	1.36E+04	-	-	-	-
SLSVS (MH)	23	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	1.83E+05	-	-	-	-
SL24 - Lightning strikes ton containers stored outdoors.																						
SLKHS (OPEN)	24	N/A	-	1.4E-10	1.0E+01	N/A	-	N/A	-	5.1E-10	1.0E+01	N/A	-	1.4E-10	1.0E+01	N/A	-	1.70E+03	1.70E+03	-	-	2 HR
SL25 - Munitions dropped during leaker isolation; munition detonates.																						
SLBGC	25	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	4.40E+02	-	-	-	-
SLDHC	25	1.7E-07	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	1.7E-07	2.6E+01	1.7E-07	2.6E+01	N/A	-	2.88E+02	-	6.00E+00	6.50E-03	2 HR
SLCGC	25	8.9E-08	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	8.9E-08	2.6E+01	N/A	-	4.80E+01	-	1.60E+00	5.45E-01	2 HR
SLCHC	25	8.9E-08	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	8.9E-08	2.6E+01	N/A	-	N/A	-	9.60E+01	-	3.20E+00	6.50E-03	2 HR
SLKGC	25	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	1.50E+03	-	-	-	-
SLKHC	25	0.0E+00	-	0.0E+00	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	1.70E+03	-	-	-	-
SLKVC	25	N/A	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	N/A	-	0.0E+00	-	N/A	-	1.60E+03	-	-	-	-
SLMVC	25	1.3E-07	2.6E+01	N/A	-	N/A	-	N/A	-	1.3E-07	2.6E+01	N/A	-	1.3E-07	2.6E+01	1.3E-07	2.6E+01	3.78E+02	-	3.15E+01	2.55E-04	2 HR
SLPGC	25	3.2E-08	2.6E+01	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-08	2.6E+01	3.2E-08	2.6E+01	5.20E+01	-	6.50E+00	2.80E+00	2 HR
SLPHC	25	3.2E-08	2.6E+01	N/A	-	3.2E-08	2.6E+01	N/A	-	N/A	-	3.2E-08	2.6E+01	3.2E-08	2.6E+01	N/A	-	9.36E+01	-	1.17E+01	1.05E-02	2 HR
SLPVC	25	3.2E-08	2.6E+01	N/A	-	3.2E-08	2.6E+01	N/A	-	N/A	-	N/A	-	3.2E-08	2.6E+01	3.2E-08	2.6E+01	4.80E+01	-	6.00E+00	1.05E-04	2 HR
SLQGC	25	3.2E-08	2.6E+01	N/A	-	3.2E-08	2.6E+01	N/A	-	N/A	-	N/A	-	3.2E-08	2.6E+01	3.2E-08	2.6E+01	8.70E+01	-	1.45E+01	2.80E+00	2 HR
SLQVC	25	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	3.2E-08	2.6E+01	3.2E-08	2.6E+01	8.70E+01	-	1.45E+01	1.05E-04	2 HR
SLRGC	25	5.7E-08	2.6E+01	N/A	-	5.7E-08	2.6E+01	N/A	-	5.7E-08	2.6E+01	N/A	-	5.7E-08	2.6E+01	5.7E-08	2.6E+01	1.60E+02	-	2.14E+01	5.80E+00	2 HR
SLRVC	25	5.7E-08	2.6E+01	N/A	-	5.7E-08	2.6E+01	N/A	-	5.7E-08	2.6E+01	N/A	-	5.7E-08	2.6E+01	5.7E-08	2.6E+01	1.50E+02	-	2.00E+01	2.08E-04	2 HR
SLSVC	25	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-	0.0E+00	-	0.0E+00	-	1.36E+03	-	-	-	-

NOTES:

See notes at end of table.

STORAGE ACCIDENTS - (Frequency units given at bottom of table)
FOR MUNITIONS AT EXISTING SITES

		Accident Frequencies																Agent Available and Released				
SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	AFG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME

1. Frequency units for scenario 1 are events per munition year.

2. Frequency units for scenarios 2, 9, and 25 are events per leaker.

3. Frequency units for scenarios 4, 5, 8, 15 through 21, and 23 are events per storage unit-year (igloo or warehouse). For ton containers stored outdoors, frequency units for scenarios 8 and 24 are events per cluster-year of ton containers (15 TC/cluster).

4. Agent release for SLHMS 1 (open) assumes outdoor spill onto a porous surface.

5. Frequency units for scenarios 7 and 22 are events per year.

21-Aug-87 PAGE 1

STORAGE EARTHQUAKE - WAREHOUSES

STORAGE - EARTHQUAKE-INDUCED ACCIDENTS IN THE WAREHOUSES
(PER YEAR)

		ACCIDENT FREQUENCIES																AGENT AVAILABLE AND RELEASED				
SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLKVF	261	N/A	N/A	N/A	N/A	N/A	N/A	1.1E-06	1.0E+01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.0E+06	-	-	7.5E+04	6 HR
SLKVC	262	N/A	N/A	N/A	N/A	N/A	N/A	9.5E-07	2.0E+01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.0E+06	-	-	NEGL	6 HR
SLKVF	263	N/A	N/A	N/A	N/A	N/A	N/A	1.1E-09	2.9E+01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.0E+06	-	-	2.0E+02	6 HR
SLKVF	264	N/A	N/A	N/A	N/A	N/A	N/A	3.3E-04	5.5E+00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.0E+06	-	-	7.5E+04	6 HR
SLKVC	265	N/A	N/A	N/A	N/A	N/A	N/A	1.4E-04	8.6E+00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.0E+06	-	-	NEGL	6 HR
SLSVF	271	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.7E-04	8.6E+00	N/A	N/A	1.8E+05	-	-	4.5E+03	6 HR
SLSVF	272	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.3E-06	7.1E+00	N/A	N/A	1.8E+05	-	-	4.5E+03	6 HR
SLSVF	273	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.1E-05	9.3E+00	N/A	N/A	3.6E+05	-	-	9.0E+03	6 HR
SLSVF	274	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.9E-06	1.1E+01	N/A	N/A	1.8E+05	-	-	4.5E+03	6 HR
SLSVF	275	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.0E-07	3.4E+01	N/A	N/A	1.8E+05	-	-	4.5E+03	6 HR
SLSVF	276	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.8E-08	2.8E+01	N/A	N/A	3.6E+05	-	-	9.0E+03	6 HR
SLKHF	281	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.8E-07	1.2E+01	5.4E+06	-	-	2.7E+05	6 HR
SLKHF	282	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.3E-05	8.8E+00	5.4E+06	-	-	5.4E+05	6 HR
SLKHF	283	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.9E-07	1.8E+01	1.1E+07	-	-	NEGL	6 HR
SLKHC	284	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.1E-10	3.1E+01	5.4E+06	-	-	2.7E+05	6 HR
SLKHF	285	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.1E-10	3.1E+01	5.4E+06	-	-	2.7E+05	6 HR
SLKHF	286	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NEGL		5.4E+06	-	-	5.4E+05	6 HR
SLKHF	287	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.5E-10	5.8E+01	1.1E+07	-	-	NEGL	6 HR
SLKHC	288	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NEGL		5.4E+06	-	-	2.7E+05	-
SLKHF	289	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NEGL		5.4E+06	-	-	5.4E+05	-
SLKHF	2810	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.4E-05	1.2E+01	5.4E+06	-	-	NEGL	6 HR
SLKHF	2811	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.9E-05	7.5E+00	1.1E+07	-	-	2.7E+05	6 HR
SLKHF	2812	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.2E-07	9.2E+00	5.4E+06	-	-	5.4E+05	6 HR
SLKHF	2813	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.6E-08	2.3E+01	5.4E+06	-	-	NEGL	6 HR
SLKHF	2814	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.9E-08	2.7E+01	5.4E+06	-	-	2.7E+05	6 HR

STORAGE EARTHQUAKE - WAREHOUSES

STORAGE - EARTHQUAKE-INDUCED ACCIDENTS IN THE WAREHOUSES
(PER YEAR)

		ACCIDENT FREQUENCIES																	AGENT AVAILABLE AND RELEASED			
SCENARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAIL.	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SLKHF	2815	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.6E-10	2.7E+01	5.4E+06	-	-	5.4E+05	6 HR
SLKHF	2816	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.6E-05	5.2E+00	5.4E+06	-	-	NEGL	6 HR
SLKHF	2817	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.1E-05	9.8E+00	1.1E+07	-	-	5.4E+05	6 HR

I.1.2. INTERIM STORAGE

The following tables list the accident results for interim storage of munitions.

File: STORHOLB.WK1 Page 1 Date 21-Aug-87

INTERIM STORAGE SCENARIOS - NATIONAL/REGIONAL DISPOSAL OPTIONS
(PER YEAR)

SCENARIO ID	NO.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
Large aircraft crash onto containers; no fire																						
SRBGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-10	10	1.5E-08	10	3.7E+05	3.1E+05	--	--	1HR
SRDHC	1	7.8E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	5.9E-08	10	3.6E-10	10	N/A	--	1.6E+05	1.1E+05	2.4E+04	--	1HR
SRCGC	1	7.8E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.5E+04	4.5E+04	9.7E+03	--	1HR
SRCHC	1	7.8E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	5.9E-08	10	3.6E-10	10	N/A	--	1.3E+05	9.0E+04	1.9E+04	--	1HR
SRKGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E+05	3.6E+05	--	--	1HR
SRKHS	1	7.8E-09	10	5.3E-10	10	N/A	--	N/A	--	1.5E-09	10	N/A	--	3.6E-10	10	1.5E-08	10	4.8E+05	4.0E+05	--	--	1HR
SRKVS	1	N/A	--	N/A	--	N/A	--	4.6E-09	10	N/A	--	N/A	--	3.6E-10	10	N/A	--	4.5E+05	3.8E+05	--	--	1HR
SRNVC	1	7.8E-09	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--	3.6E-10	10	1.5E-08	10	1.6E+05	1.1E+05	2.4E+04	--	1HR
SRPGC	1	7.8E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-10	10	1.5E-08	10	1.1E+05	7.6E+04	1.6E+04	--	1HR
SRPHC	1	7.8E-09	10	N/A	--	4.5E-09	10	N/A	--	N/A	--	5.9E-08	10	3.6E-10	10	N/A	--	2.0E+05	1.4E+05	2.9E+04	--	1HR
SRPVC	1	7.8E-09	10	N/A	--	4.5E-09	10	N/A	--	N/A	--	N/A	--	3.6E-10	10	1.5E-08	10	1.0E+05	7.1E+04	1.5E+04	--	1HR
SRQGC	1	7.8E-09	10	N/A	--	4.5E-09	10	N/A	--	N/A	--	N/A	--	3.6E-10	10	1.5E-08	10	1.2E+05	8.5E+04	1.8E+04	--	1HR
SRQVC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-10	10	1.5E-08	10	1.2E+05	8.5E+04	1.8E+04	--	1HR
SRRGC	1	7.8E-09	10	N/A	--	4.5E-09	10	N/A	--	1.5E-09	10	N/A	--	3.6E-10	10	1.5E-09	10	9.0E+04	6.3E+04	1.3E+04	--	1HR
SRRVC	1	7.8E-09	10	N/A	--	4.5E-09	10	N/A	--	1.5E-09	10	N/A	--	3.6E-10	10	1.5E-08	10	8.4E+04	5.9E+04	1.3E+04	--	1HR
SRSVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-10	10	1.5E-08	10	1.9E+05	1.6E+05	--	--	
Large aircraft crash onto containers; fire not contained																						
SRBGF	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	10	7.9E-09	10	3.7E+05	--	--	3.7E+04	1HR
SRDHC	2	4.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-08	10	1.9E-10	10	N/A	--	1.6E+05	--	4.0E+04	6.0E+03	20MIN
SRCGC	2	4.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.5E+04	--	1.6E+04	4.8E+03	20MIN
SRCHC	2	4.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-08	10	1.9E-10	10	N/A	--	1.3E+05	--	3.2E+04	4.8E+03	20MIN
SRKGF	2	N/A	-	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E+05	--	--	4.2E+04	1HR
SRKHF	2	4.2E-09	10	2.8E-10	10	N/A	--	N/A	--	7.9E-10	10	N/A	--	1.9E-10	10	7.9E-09	10	4.8E+05	--	--	2.4E+04	1HR
SRKVF	2	N/A	--	N/A	--	N/A	--	2.4E-09	10	N/A	--	N/A	--	1.9E-10	10	N/A	--	4.5E+05	--	--	1.1E+04	1HR
SRNVC	2	4.2E-09	10	N/A	--	N/A	--	N/A	--	7.9E-10	10	N/A	--	1.9E-10	10	7.9E-09	10	1.6E+05	--	4.0E+04	3.0E+03	20MIN
SRPGC	2	4.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	10	7.9E-09	10	1.1E+05	--	2.7E+04	8.2E+03	20MIN
SRPHC	2	4.2E-09	10	N/A	--	2.4E-09	10	N/A	--	N/A	--	3.1E-08	10	1.9E-10	10	N/A	--	2.0E+05	--	4.9E+04	7.4E+03	20MIN
SRPVC	2	4.2E-09	10	N/A	--	2.4E-09	10	N/A	--	N/A	--	N/A	--	1.9E-10	10	7.9E-09	10	1.0E+05	--	2.5E+04	1.9E+03	20MIN

File: STORHOLD.WK1 Page 2 Date 21-Aug-87

INTERIM STORAGE SCENARIOS - NATIONAL/REGIONAL DISPOSAL OPTIONS
(PER YEAR)

SCENARIO ID	NO.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SRQGC	2	4.2E-09	10	N/A	--	2.4E-09	10	N/A	--	N/A	--	N/A	--	1.9E-10	10	7.9E-09	10	1.2E+05	--	3.0E+04	9.1E+03	20MIN
SRQVC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	10	7.9E-09	10	1.2E+05	--	3.0E+04	2.3E+03	20MIN
SRRGC	2	4.2E-09	10	N/A	--	2.4E-09	10	N/A	--	7.9E-10	10	N/A	--	1.9E-10	10	7.9E-09	10	9.0E+04	--	2.2E+04	6.7E+03	20MIN
SRRVC	2	4.2E-09	10	N/A	--	2.4E-09	10	N/A	--	7.9E-10	10	N/A	--	1.9E-10	10	7.9E-09	10	8.4E+04	--	2.1E+04	1.6E+03	20MIN
SRSVF	2	N/A	-	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	10	7.9E-09	10	1.9E+05	--	--	4.7E+03	1HR
Large aircraft crash onto containers; fire contained																						
SRBGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11	3.7E+05	--	--	3.1E+04	1HR
SRDHC	3	2.2E-09	11	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-08	11	1.0E-10	11	N/A	--	1.6E+05	--	--	--	-
SPCGC	3	2.2E-09	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.5E+04	--	--	--	--
SPCHC	3	2.2E-09	11	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-08	11	1.0E-10	11	N/A	--	1.3E+05	--	--	--	--
SRKGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E+05	--	--	3.6E+04	1HR
SRKHF	3	2.2E-09	11	1.5E-10	11	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11	4.8E+05	--	--	2.0E+04	1HR
SRKVF	3	N/A	--	N/A	--	N/A	--	1.3E-09	11	N/A	--	N/A	--	1.0E-10	11	N/A	--	4.5E+05	--	--	9.5E+03	1HR
SRMVC	3	2.2E-09	11	N/A	--	N/A	--	N/A	--	4.3E-10	11	N/A	--	1.0E-10	11	4.3E-09	11	1.6E+05	--	--	--	--
SRPGC	3	2.2E-09	11	N/A	-	N/A	--	N/A	-	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11	1.1E+05	--	--	--	--
SRPHC	3	2.2E-09	11	N/A	--	1.3E-09	11	N/A	--	N/A	--	1.7E-08	11	1.0E-10	11	N/A	--	2.0E+05	--	--	--	--
SRPVC	3	2.2E-09	11	N/A	--	1.3E-09	11	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11	1.0E+05	--	--	--	--
SRQGC	3	2.2E-09	11	N/A	--	1.3E-09	11	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11	1.2E+05	--	--	--	--
SRQVC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11	1.2E+05	--	--	--	--
SRRGC	3	2.2E-09	11	N/A	-	1.3E-09	11	N/A	--	4.3E-10	11	N/A	--	1.0E-10	11	4.3E-09	11	9.0E+04	--	--	--	--
SRRVC	3	2.2E-09	11	N/A	--	1.3E-09	11	N/A	--	4.3E-10	11	N/A	--	1.0E-10	11	4.3E-09	11	8.4E+04	-	--	--	--
SRSVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	11	4.3E-09	11	1.9E+05	--	--	4.0E+03	1HR
Small aircraft crash onto containers; no fire																						
SRBGS	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	10	1.2E-08	10	3.7E+05	2.2E+03	--	--	1HR
SRDHC	4	1.2E-08	10	N/A	--	N/A	--	N/A	--	N/A	--	9.9E-08	10	1.4E-08	10	N/A	--	1.6E+05	--	1.7E+02	8.1E+02	1HR
SRCGC	4	1.2E-08	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.5E+04	--	6.9E+01	3.2E+02	1HR
SRCHC	4	1.2E-08	10	N/A	--	N/A	--	N/A	--	N/A	--	9.9E-08	10	1.4E-08	10	N/A	--	1.3E+05	--	1.4E+02	6.5E+02	1HR
SRKGS	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E+05	2.6E+03	--	--	1HR
SRKHS	4	1.2E-08	10	7.7E-06	10	N/A	--	N/A	--	1.1E-07	10	N/A	--	1.4E-08	10	1.2E-08	10	4.8E+05	2.9E+03	--	--	1HR

File: STORHOLD.WK1 Page 3 Date 21-Aug-87

INTERIM STORAGE SCENARIOS - NATIONAL/REGIONAL DISPOSAL OPTIONS
(PER YEAR)

SCENARIO ID	NO.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SRKVS	4	N/A	--	N/A	--	N/A	--	2.3E-08	10	N/A	--	N/A	--	1.4E-08	10	N/A	--	4.5E+05	2.7E+03	--	--	1HR
SRNVC	4	1.2E-08	10	N/A	--	N/A	--	N/A	--	1.1E-07	10	N/A	--	1.4E-08	10	1.2E-08	10	1.6E+05	--	1.7E+02	7.9E+02	1HR
SRPGC	4	1.2E-08	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	10	1.2E-08	10	1.1E+05	--	1.2E+02	5.5E+02	1HR
SRPHC	4	1.2E-08	10	N/A	--	1.8E-10	10	N/A	--	N/A	--	9.9E-08	10	1.4E-08	10	N/A	--	2.0E+05	--	2.1E+02	9.8E+02	1HR
SRPVC	4	1.2E-08	10	N/A	--	1.8E-10	10	N/A	--	N/A	--	N/A	--	1.4E-08	10	1.2E-08	10	1.0E+05	--	1.1E+02	5.0E+02	1HR
SRQGC	4	1.2E-08	10	N/A	--	1.8E-10	10	N/A	--	N/A	--	N/A	--	1.4E-08	10	1.2E-08	10	1.2E+05	--	1.3E+02	6.1E+02	1HR
SRQVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	10	1.2E-08	10	1.2E+05	--	1.3E+02	6.1E+02	1HR
SPRGC	4	1.2E-08	10	N/A	--	1.8E-10	10	N/A	--	1.1E-07	10	N/A	--	1.4E-08	10	1.2E-08	10	9.0E+04	--	9.6E+01	4.5E+02	1HR
SRRVC	4	1.2E-08	10	N/A	--	1.8E-10	10	N/A	--	1.1E-07	10	N/A	--	1.4E-08	10	1.2E-08	10	8.4E+04	--	9.0E+01	4.2E+02	1HR
SRSVS	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	10	1.2E-08	10	1.9E+05	1.2E+03	--	--	1HR
Small aircraft crash onto containers; fire not contained																						
SRBGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-09	10	1.3E-09	10	3.7E+05	--	--	3.7E+04	1HR
SRDHC	5	1.3E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-08	10	1.5E-09	10	N/A	--	1.6E+05	--	4.0E+04	6.0E+03	20MIN
SRCGC	5	1.3E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.5E+04	--	1.6E+04	4.0E+03	20MIN
SRCHC	5	1.3E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-08	10	1.5E-09	10	N/A	--	1.3E+05	--	3.2E+04	4.8E+03	20MIN
SRKGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E+05	--	--	4.2E+04	1HR
SRKHF	5	1.3E-09	10	8.2E-07	10	N/A	--	N/A	--	1.2E-08	10	N/A	--	1.5E-09	10	1.3E-09	10	4.8E+05	--	--	2.4E+04	1HR
SRKVF	5	N/A	--	N/A	--	N/A	--	2.4E-09	10	N/A	--	N/A	--	1.5E-09	10	N/A	--	4.5E+05	--	--	1.1E+04	1HR
SRNVC	5	1.3E-09	10	N/A	--	N/A	--	N/A	--	1.2E-08	10	N/A	--	1.5E-09	10	1.3E-09	10	1.6E+05	--	4.0E+04	3.0E+03	20MIN
SRPGC	5	1.3E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-09	10	1.3E-09	10	1.1E+05	--	2.7E+04	8.2E+03	20MIN
SRPHC	5	1.3E-09	10	N/A	--	1.9E-11	10	N/A	--	N/A	--	1.1E-08	10	1.5E-09	10	N/A	--	2.0E+05	--	4.9E+04	7.4E+03	20MIN
SRPVC	5	1.3E-09	10	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	1.3E-09	10	1.0E+05	--	2.5E+04	1.9E+03	20MIN
SRQGC	5	1.3E-09	10	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	1.3E-09	10	1.2E+05	--	3.0E+04	9.1E+03	20MIN
SRQVC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-09	10	1.3E-09	10	1.2E+05	--	3.0E+04	2.3E+03	20MIN
SPRGC	5	1.3E-09	10	N/A	--	1.9E-11	10	N/A	--	1.2E-08	10	N/A	--	1.5E-09	10	1.3E-09	10	9.0E+04	--	2.2E+04	6.7E+03	20MIN
SRRVC	5	1.3E-09	10	N/A	--	1.9E-11	10	N/A	--	1.2E-08	10	N/A	--	1.5E-09	10	1.3E-09	10	8.4E+04	--	2.1E+04	1.6E+03	20MIN
SRSVF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-09	10	1.3E-09	10	1.9E+05	--	--	4.7E+03	1HR
Small aircraft crash onto containers; fire contained																						
SRBGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	10	8.5E-09	10	3.7E+05	--	--	2.2E+02	1HR

File: STORHOLD.WK1 Page 4 Date 21-Aug-87

INTERIM STORAGE SCENARIOS - NATIONAL/REGIONAL DISPOSAL OPTIONS
(PER YEAR)

SCENARIO ID	NO.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SRDHC	6	5.6E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-08	10	1.0E-08	10	N/A	--	1.6E+05	--	--	--	--
SRCGC	6	5.6E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.5E+04	--	--	--	-
SRCHC	6	5.6E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-08	10	1.0E-08	10	N/A	--	1.3E+05	--	--	--	--
SRKGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E+05	--	--	2.6E+02	1HR
SRKHF	6	5.6E-09	10	5.5E-06	10	N/A	--	N/A	--	7.8E-08	10	N/A	--	1.0E-08	10	8.5E-09	10	4.8E+05	--	--	1.4E+02	1HR
SRKVF	6	N/A	--	N/A	--	N/A	--	1.6E-08	10	N/A	--	N/A	--	1.0E-08	10	N/A	--	4.5E+05	--	--	6.8E+01	1HR
SRNVC	6	5.6E-09	10	N/A	--	N/A	--	N/A	--	7.8E-08	10	N/A	--	1.0E-08	10	8.5E-09	10	1.6E+05	--	--	--	--
SRPGC	6	5.6E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	10	8.5E-09	10	1.1E+05	--	--	--	--
SRPHC	6	5.6E-09	10	N/A	--	1.3E-10	10	N/A	--	N/A	--	7.1E-08	10	1.0E-08	10	N/A	--	2.0E+05	--	--	--	--
SRPVC	6	5.6E-09	10	N/A	--	1.3E-10	10	N/A	--	N/A	--	N/A	--	1.0E-08	10	8.5E-09	10	1.0E+05	--	--	--	--
SRQGC	6	5.6E-09	10	N/A	--	1.3E-10	10	N/A	--	N/A	--	N/A	--	1.0E-08	10	8.5E-09	10	1.2E+05	--	--	--	--
SRQVC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	10	8.5E-09	10	1.2E+05	--	--	--	--
SRRGC	6	5.6E-09	10	N/A	--	1.3E-10	10	N/A	--	7.8E-08	10	N/A	--	1.0E-08	10	8.5E-09	10	9.0E+04	--	--	--	--
SRRVC	6	5.6E-09	10	N/A	--	1.3E-10	10	N/A	--	7.8E-08	10	N/A	--	1.0E-08	10	8.5E-09	10	8.4E+04	--	--	--	--
SRSVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	10	8.5E-09	10	1.9E+05	--	--	2.9E+01	1HR
Tornado-generated missiles penetrate containers; no detonation																						
SRDGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E 16	94	9.6E-16	94	3.7E+05	--	--	1.8E+00	2HR
SRDHS	7	1.5E-11	94	N/A	--	N/A	--	N/A	--	N/A	--	6.2E-13	94	5.5E-15	94	N/A	--	1.6E+05	--	--	8.3E-02	2HR
SRCGS	7	9.1E-12	94	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-15	94	N/A	--	6.5E+04	--	--	1.8E+00	2HR
SRCHS	7	9.1E-12	94	N/A	--	N/A	--	N/A	--	N/A	--	3.8E-13	94	N/A	--	N/A	--	1.3E+05	--	--	8.3E-02	2HR
SRKGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E+05	--	--	1.8E+00	2HR
SRKHS	7	2.4E-12	94	7.8E-14	94	N/A	--	N/A	--	2.4E-12	94	N/A	--	5.0E-16	94	5.0E-16	94	4.8E+05	--	--	8.3E-02	2HR
SRKVS	7	N/A	--	N/A	--	N/A	--	2.4E-12	94	N/A	--	N/A	--	5.0E-16	94	N/A	--	4.5E+05	--	--	1.9E-03	2HR
SRNVS	7	1.3E-11	94	N/A	--	N/A	--	N/A	--	1.3E-11	94	N/A	--	4.9E-15	94	4.9E-15	94	1.6E+05	--	--	1.0E-03	2HR
SRPGS	7	7.8E-12	94	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-15	94	2.7E-15	94	1.1E+05	--	--	1.8E+00	2HR
SRPHS	7	7.9E-12	94	N/A	--	7.8E-12	94	N/A	--	N/A	--	3.2E-13	94	2.7E-15	94	N/A	--	2.0E+05	--	--	8.3E-02	2HR
SRPVS	7	7.8E-12	94	N/A	--	7.8E-12	94	N/A	--	N/A	--	N/A	--	2.7E-15	94	2.7E-15	94	1.0E+05	--	--	1.0E-03	2HR
SRQGS	7	7.8E-12	94	N/A	--	7.8E-12	94	N/A	--	N/A	--	N/A	--	2.7E-15	94	2.7E-15	94	1.2E+05	--	--	1.8E+00	2HR
SRQVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-15	94	2.7E-15	94	1.2E+05	--	--	1.0E-03	2HR

INTERIM STORAGE SCENARIOS - NATIONAL/REGIONAL DISPOSAL OPTIONS
(PER YEAR)

SCENARIO ID	NO.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SRRGS	7	1.7E-11	94	N/A	--	1.7E-11	94	N/A	--	1.7E-11	94	N/A	--	6.2E-15	94	6.2E-15	94	9.0E+04	--	--	1.8E+00	2HR
SRRVS	7	1.7E-11	94	N/A	--	1.7E-11	94	N/A	--	1.7E-11	94	N/A	--	6.2E-15	94	6.2E-15	94	8.4E+04	--	--	1.0E-03	2HR
SRSVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-15	94	1.7E-15	94	1.9E+05	--	--	1.0E-03	2HR
Tornado-generated missile penetrate containers; detonation (or motor ignition for rockets)																						
SRDHC	8	5.6E-12	99	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-13	99	5.9E-15	99	N/A	--	1.6E+05	3.0E+01	6.0E+00	--	2HR
SRCGC	8	3.4E-12	99	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-15	99	N/A	--	6.5E+04	8.0E+00	1.6E+00	--	2HR
SRCHC	8	3.4E-12	99	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-13	99	N/A	--	N/A	--	1.3E+05	1.6E+01	3.2E+00	--	2HR
SRMVC	8	4.9E-12	99	N/A	--	N/A	--	N/A	--	4.9E-12	99	N/A	--	1.8E-15	99	1.8E-15	99	1.6E+05	1.1E+03	0.0E+00	--	2HR
SRPGC	8	2.9E-12	99	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-15	99	1.0E-15	99	1.1E+05	3.2E+01	0.0E+00	--	2HR
SRPHC	8	2.9E-12	99	N/A	--	2.9E-12	94	N/A	--	N/A	--	3.5E-13	99	1.0E-15	99	N/A	--	2.0E+05	5.8E+01	0.0E+00	--	2HR
SRPVC	8	2.9E-12	99	N/A	--	2.9E-12	94	N/A	--	N/A	--	N/A	--	1.0E-15	99	1.0E-15	99	1.0E+05	3.0E+01	3.2E+01	--	2HR
SRQGC	8	2.9E-12	99	N/A	--	2.9E-12	94	N/A	--	N/A	--	N/A	--	1.0E-15	99	1.0E-15	99	1.2E+05	7.3E+01	6.5E+00	--	2HR
SRQVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-15	99	1.0E-15	99	1.2E+05	7.3E+01	1.2E+01	--	2HR
SRRGC	C	1.8E-11	94	N/A	--	1.8E-11	94	N/A	--	1.8E-11	94	N/A	--	6.6E-15	94	6.6E-15	94	9.0E+04	6.2E+02	6.0E+00	--	2HR
SRRVC	8	1.8E-11	94	N/A	--	1.8E-11	94	N/A	--	1.8E-11	94	N/A	--	6.6E-15	94	6.6E-15	94	8.4E+04	5.8E+02	1.5E+01	--	2HR
Meteorite strikes the holding area																						
SRBGF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-10	26	2.0E-10	26	3.7E+05	--	--	2.6E+02	1HR
SRDHC	9	1.8E-10	26	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-10	26	1.8E-10	26	N/A	--	1.6E+05	--	2.9E+02	4.3E+01	20MIN
SRCGC	9	2.2E-10	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.5E+04	--	1.2E+02	3.5E+01	20MIN
SRCHC	9	2.2E-10	26	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	26	2.2E-10	26	N/A	--	1.3E+05	--	2.3E+02	3.5E+01	20MIN
SRKGF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E+05	--	--	3.0E+02	1HR
SRKHF	9	1.9E-10	26	1.9E-10	26	N/A	--	N/A	--	1.9E-10	26	N/A	--	1.9E-10	26	1.9E-10	26	4.8E+05	--	--	1.7E+02	1HR
SRKVF	9	N/A	--	N/A	--	N/A	--	1.9E-10	26	N/A	--	N/A	--	N/A	--	N/A	--	4.5E+05	--	--	8.0E+01	1HR
SRMVC	9	2.0E-10	26	N/A	--	N/A	--	N/A	--	2.0E-10	26	N/A	--	2.0E-10	26	2.0E-10	26	1.6E+05	--	2.8E+02	2.1E+01	20MIN
SRPGC	9	2.1E-10	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	26	2.1E-10	26	1.1E+05	--	2.0E+02	5.8E+01	20MIN
SRPHC	9	2.1E-10	26	N/A	--	2.1E-10	26	N/A	--	N/A	--	2.1E-10	26	2.1E-10	26	N/A	--	2.0E+05	--	3.5E+02	5.3E+01	20MIN
SRPVC	9	2.1E-10	26	N/A	--	2.1E-10	26	N/A	--	N/A	--	N/A	--	2.1E-10	26	2.1E-10	26	1.0E+05	--	1.8E+02	1.4E+01	20MIN
SRQGC	9	2.1E-10	26	N/A	--	2.1E-10	26	N/A	--	N/A	--	N/A	--	2.1E-10	26	2.1E-10	26	1.2E+05	--	2.2E+02	6.5E+01	20MIN
SRQVC	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	26	2.1E-10	26	1.2E+05	--	2.2E+02	1.6E+01	20MIN

File: STORHOLD.WK1 Page 6 Date 21-Aug-87

INTERIM STORAGE SCENARIOS - NATIONAL/REGIONAL DISPOSAL OPTIONS
(PER YEAR)

SCENARIO ID	NO.	AMAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SRRGC	9	1.9E-10	26	N/A	--	1.9E-10	26	N/A	--	1.9E-10	26	N/A	--	1.9E-10	26	1.9E-10	26	9.0E+04	--	1.6E+02	4.8E+01	20MIN
SRRVC	9	1.9E-10	26	N/A	--	1.9E-10	26	N/A	--	1.9E-10	26	N/A	--	1.9E-10	26	1.9E-10	26	8.4E+04	--	1.5E+02	1.1E+01	20MIN
SRSVC	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-10	26	3.2E-10	26	1.9E+05	--	--	3.4E+01	1HR

File: STORHOLD.WK1 Page 1 Date 21-Aug-87

Interim Storage Barge Only (events/yr)

SCENARIO ID	NO.	APG	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
Large aircraft crash onto holding area; no fire								
SWKHS	1	2.0E-11	10	238000	202300.0	--	--	1HR
Large aircraft crash onto holding area; fire not contained								
SWKHF	2	1.1E-11	10	238000	--	--	11900.0	1HR
Large aircraft crash onto holding area; fire contained								
SWKHF	3	5.8E-12	11	238000	--	--	10115.0	1HR
Small aircraft crash onto holding area; no fire								
SWKHS	4	3.0E-07	10	238000	2890.0	--	--	1HR
Small aircraft crash onto holding area; fire not contained								
SWKHF	5	3.2E-08	11	238000	--	--	11900.0	1HR
Small aircraft crash onto holding area; fire contained								
SWKHF	6	2.1E-07	10	238000	--	--	144.5	1HR
Tornado-generated missile penetrates vault								
SWKHC	7	2.5E-14	94	238000	--	--	0.1	2HR
Meteorite strikes vault								
SWKHF	9	1.0E-10	26	238000	--	--	85.0	1HR
Large aircraft crash onto lighter; no fire								
SWKHS	10	7.7E-12	10	95200	--	--	1040.0	24HR
Large aircraft crash onto lighter; fire not contained								
SWKHF	11	4.1E-12	10	95200	--	--	4962.3	1HR
Large aircraft crash onto lighter; fire contained								
SWKHF	12	2.2E-12	11	95200	--	--	202.3	1HR
Small aircraft crash onto lighter; no fire								
SWKHS	13	1.2E-07	10	95200	--	--	3.1	1HR
Small aircraft crash onto lighter; fire not contained								
SWKHF	14	1.2E-08	11	95200	--	--	4760.0	1HR
Small aircraft crash onto lighter; fire contained								
SWKHF	15	8.2E-08	10	95200	--	--	680.0	1HR
Large aircraft crash onto ship; no fire								
SWKHS	16	3.3E-11	10	3808000	--	--	350.0	6HR
Large aircraft crash onto ship; fire not contained								

File: STORHOLD.WK1 Page 2 Date 21-Aug-87

Interim SInterim Storage Barge Only (events/yr)

SCENARIO ID	NO.	APG	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SWKHF	17	1.8E-11	10	3808000	--	--	60520.0	1HR
Large aircraft crash onto ship; fire contained								
SWKHF	18	9.5E-12	11	3808000	--	--	3400.0	1HR
Small aircraft crash onto ship; no fire								
SWKHS	19	4.8E-07	10	3808000	--	--	19.3	2HR
Small aircraft crash onto ship; fire not contained								
SWKHF	20	5.1E-08	11	3808000	--	--	57375.0	1HR
Small aircraft crash onto ship; fire contained								
SWKHF	21	3.4E-07	10	3808000	--	--	255.0	1HR

File: STORHOLD.WK1 Page 1 Date 21-Aug-87

INTERIM STORAGE AIR OPTION (EVENTS/YR)

Scenario	No.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
Large aircraft crash onto containers; no fire																						
SAKHS	1	N/A	--	6.0E-10	10	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	10	N/A	--	51000	43350.0	--	--	1HR
SAPHC	1	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	3.3E-09	10	N/A	--	21060	14742.0	3159.0	--	1HR
SAPVC	1	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	3.3E-09	10	N/A	--	10800	7560.0	1620.0	--	1HR
SAQGC	1	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	3.3E-09	10	N/A	--	13050	9135.0	1957.5	--	1HR
SARGC	1	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	3.3E-09	10	N/A	--	9630	6741.0	1444.5	--	1HR
SARVC	1	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	3.3E-09	10	N/A	--	9000	6300.0	1350.0	--	1HR
Large aircraft crash onto containers; fire not contained																						
SAKHF	2	N/A	--	3.2E-10	10	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-09	10	N/A	--	51000	--	--	2550.0	1HR
SAPHC	2	N/A	--	N/A	--	1.7E-09	10	N/A	--	N/A	--	N/A	--	1.8E-09	10	N/A	--	21060	--	5265.0	789.8	20MIN
SAPVC	2	N/A	--	N/A	--	1.7E-09	10	N/A	--	N/A	--	N/A	--	1.8E-09	10	N/A	--	10800	--	2700.0	202.5	20MIN
SAQGC	2	N/A	--	N/A	--	1.7E-09	10	N/A	--	N/A	--	N/A	--	1.8E-09	10	N/A	--	13050	--	3262.5	978.8	20MIN
SARGC	2	N/A	--	N/A	--	1.7E-09	10	N/A	--	N/A	--	N/A	--	1.8E-09	10	N/A	--	9630	--	2407.5	722.3	20MIN
SARVC	2	N/A	--	N/A	--	1.7E-09	10	N/A	--	N/A	--	N/A	--	1.8E-09	10	N/A	--	9000	--	2250.0	168.8	20MIN
Large aircraft crash onto containers; fire contained																						
SAKHF	3	N/A	--	1.7E-10	11	N/A	--	N/A	--	N/A	--	N/A	--	9.4E-10	11	N/A	--	51000	--	--	2167.5	1HR
SAPHC	3	N/A	--	N/A	--	9.1E-10	11	N/A	--	N/A	--	N/A	--	9.4E-10	11	N/A	--	21060	--	--	--	--
SAPVC	3	N/A	--	N/A	--	9.1E-10	11	N/A	--	N/A	--	N/A	--	9.4E-10	11	N/A	--	10800	--	--	--	--
SAQGC	3	N/A	--	N/A	--	9.1E-10	11	N/A	--	N/A	--	N/A	--	9.4E-10	11	N/A	--	13050	--	--	--	--
SARGC	3	N/A	--	N/A	--	9.1E-10	11	N/A	--	N/A	--	N/A	--	9.4E-10	11	N/A	--	9630	--	--	--	--
SARVC	3	N/A	--	N/A	--	9.1E-10	11	N/A	--	N/A	--	N/A	--	9.4E-10	11	N/A	--	9000	--	--	--	--
Small aircraft crash onto containers; no fire																						
SAKHS	4	N/A	--	8.3E-07	10	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--	51000	2890.0	--	--	1HR
SAPHC	4	N/A	--	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--	21060	982.8	210.6	--	1HR
SAPVC	4	N/A	--	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--	10800	504.0	108.0	--	1HR
SAQGC	4	N/A	--	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--	13050	609.0	130.5	--	1HR
SARGC	4	N/A	--	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--	9630	449.4	96.3	--	1HR
SARVC	4	N/A	--	N/A	--	1.9E-11	10	N/A	--	N/A	--	N/A	--	1.5E-09	10	N/A	--	9000	420.0	90.0	--	1HR
Small aircraft crash onto containers; fire not contained																						
SAKHF	5	N/A	--	8.8E-08	11	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	11	N/A	--	51000	--	--	2550.0	1HR

File: STORWOLB.WK1 Page 2 Date 21-Aug 87

INTERIM STORAGE AIR OPTION (EVENTS/YR)

Scenario	No.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SAPHC	5	N/A	--	N/A	--	2.0E-12	11	N/A	--	N/A	--	N/A	--	1.6E-10	11	N/A	--	21060	--	5265.0	789.8	20MIN
SAPVC	5	N/A	--	N/A	--	2.0E-12	11	N/A	--	N/A	--	N/A	--	1.6E-10	11	N/A	--	10800	--	2700.0	202.5	20MIN
SAQGC	5	N/A	--	N/A	--	2.0E-12	11	N/A	--	N/A	--	N/A	--	1.6E-10	11	N/A	--	13050	--	3262.5	978.8	20MIN
SARGC	5	N/A	--	N/A	--	2.0E-12	11	N/A	--	N/A	--	N/A	--	1.6E-10	11	N/A	--	9630	--	2407.5	722.3	20MIN
SARVC	5	N/A	--	N/A	--	2.0E-12	11	N/A	--	N/A	--	N/A	--	1.6E-10	11	N/A	--	9000	--	2250.0	168.8	20MIN
Small aircraft crash onto containers; fire contained																						
SAKHF	6	N/A	--	5.9E-07	10	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	10	N/A	--	51000	--	--	144.5	2HR
SAPHC	6	N/A	--	N/A	--	1.4E-11	10	N/A	--	N/A	--	N/A	--	1.1E-09	10	N/A	--	21060	--	--	--	--
SAPVC	6	N/A	--	N/A	--	1.4E-11	10	N/A	--	N/A	--	N/A	--	1.1E-09	10	N/A	--	10800	--	--	--	--
SAQGC	6	N/A	--	N/A	--	1.4E-11	10	N/A	--	N/A	--	N/A	--	1.1E-09	10	N/A	--	13050	--	--	--	--
SARGC	6	N/A	--	N/A	--	1.4E-11	10	N/A	--	N/A	--	N/A	--	1.1E-09	10	N/A	--	9630	--	--	--	--
SARVC	6	N/A	--	N/A	--	1.4E-11	10	N/A	--	N/A	--	N/A	--	1.1E-09	10	N/A	--	9000	--	--	--	--
Tornado-generated missiles penetrate containers; no detonation																						
SAKHS	7	N/A	--	8.4E-14	94	N/A	--	N/A	--	N/A	--	N/A	--	5.0E-16	94	N/A	--	51000	--	--	0.1	2HR
SAPHS	7	N/A	--	N/A	--	8.4E-13	94	N/A	--	N/A	--	N/A	--	2.7E-15	94	N/A	--	21060	--	--	0.1	2HR
SAPVS	7	N/A	--	N/A	--	8.4E-13	94	N/A	--	N/A	--	N/A	--	2.7E-15	94	N/A	--	10800	--	--	0.0	2HR
SAQGS	7	N/A	--	N/A	--	8.4E-13	94	N/A	--	N/A	--	N/A	--	2.7E-15	94	N/A	--	13050	--	--	1.8	2HR
SARGS	7	N/A	--	N/A	--	1.8E-12	94	N/A	--	N/A	--	N/A	--	6.2E-15	94	N/A	--	9630	--	--	1.8	2HR
SARVS	7	N/A	--	N/A	--	1.8E-12	94	N/A	--	N/A	--	N/A	--	6.2E-15	94	N/A	--	9000	--	--	0.0	2HR
Tornado-generated missile penetrate containers; detonation (or motor ignition for rockets)																						
SAPHC	8	N/A	--	N/A	--	3.1E-13	99	N/A	--	N/A	--	N/A	--	1.0E-15	99	N/A	--	21060	58.5	11.7	--	2HR
SAPVC	8	N/A	--	N/A	--	3.1E-13	99	N/A	--	N/A	--	N/A	--	1.0E-15	99	N/A	--	10800	30.0	6.0	--	2HR
SAQGC	8	N/A	--	N/A	--	3.1E-13	99	N/A	--	N/A	--	N/A	--	1.0E-15	99	N/A	--	13050	72.5	14.5	--	2HR
SARGC	8	N/A	--	N/A	--	1.9E-12	94	N/A	--	N/A	--	N/A	--	6.6E-15	94	N/A	--	9630	620.6	21.4	--	2HR
SARVC	8	N/A	--	N/A	--	1.9E-12	94	N/A	--	N/A	--	N/A	--	6.6E-15	94	N/A	--	9000	580.0	20.0	--	2HR
Meteorite strikes the holding area																						
SAKHF	9	N/A	--	2.0E-11	26	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-11	26	N/A	--	51000	--	--	170.0	1HR
SAPHC	9	N/A	--	N/A	--	2.2E-11	26	N/A	--	N/A	--	N/A	--	2.2E-11	26	N/A	--	21060	--	351.0	52.7	20MIN
SAPVC	9	N/A	--	N/A	--	2.2E-11	26	N/A	--	N/A	--	N/A	--	2.2E-11	26	N/A	--	10800	--	180.0	13.5	20MIN
SAQGC	9	N/A	--	N/A	--	2.2E-11	26	N/A	--	N/A	--	N/A	--	2.2E-11	26	N/A	--	13050	--	217.5	65.3	20MIN

INTERIM STORAGE AIR OPTION (EVENTS/YR)

Scenario	No.	ANAD	RANGE FACTOR	APG	RANGE FACTOR	LBAD	RANGE FACTOR	NAAP	RANGE FACTOR	PBA	RANGE FACTOR	PUDA	RANGE FACTOR	TEAD	RANGE FACTOR	UMDA	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
SARGC	9	N/A	--	N/A	--	2.0E-11	26	N/A	--	N/A	--	N/A	--	2.0E-11	26	N/A	--	9630	--	160.5	48.2	20MIN
SARVC	9	N/A	--	N/A	--	2.0E-11	26	N/A	--	N/A	--	N/A	--	2.0E-11	26	N/A	--	9000	--	150.0	11.3	20MIN

I.1.3. HANDLING

The following tables list the accident results for handling of munitions.

File: HDLREGST.WK1   17-Aug-87   Page 1

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCBGC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-07	1.3E+01	6.1E-08	1.3E+01	440.0	--	--	4.3E+00	1HR
HCBHC	1	3.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	1.3E+01	3.2E-08	1.3E+01	N/A	--	208.0	--	--	1.3E-03	1HR
HCCGC	1	5.7E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.7E-09	1.3E+01	N/A	--	38.4	--	--	1.1E-01	1HR
HCCHC	1	5.7E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-09	1.3E+01	5.7E-09	1.3E+01	N/A	--	76.8	--	--	1.3E-03	1HR
HCKGC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.0E-08	1.3E+01	N/A	--	1500.0	--	--	6.4E+00	1HR
HCKHC	1	4.0E-08	1.3E+01	2.0E-08	1.3E+01	N/A	--	N/A	--	2.0E-08	1.3E+01	N/A	--	4.0E-08	1.3E+01	2.0E-08	1.3E+01	1700.0	--	--	2.5E-02	1HR
HCKVC	1	4.0E-08	1.3E+01	N/A	--	N/A	--	2.0E-08	1.3E+01	N/A	--	N/A	--	4.0E-08	1.3E+01	N/A	--	1600.0	--	--	2.7E-04	1HR
HCMVC	1	2.4E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	2.4E-08	1.3E+01	1.2E-08	1.3E+01	378.0	--	--	1.7E-05	1HR
HCPGC	1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	52.0	--	--	--	--
HCPHC	1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HCPVC	1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	48.0	--	--	--	--
HCQGC	1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HCQVC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HCRGC	1	9.5E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	9.5E-08	1.3E+01	4.8E-08	1.3E+01	160.5	--	--	4.5E-01	1HR
HCRVC	1	9.5E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	9.5E-08	1.3E+01	4.8E-08	1.3E+01	150.0	--	--	1.6E-05	1HR
HCSVC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-06	1.3E+01	5.2E-07	1.3E+01	1356.0	--	--	2.7E-04	1HR
HCKHF	2	N/A	--	5.2E-10	3.1E+01	N/A	--	N/A	--	5.2E-10	3.1E+01	N/A	--	5.2E-10	3.1E+01	N/A	--	1700.0	--	--	8.5E+01	10 MIN
HCBGC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-07	1.3E+01	1.3E-07	1.3E+01	440.0	--	--	4.3E+00	1HR
HCBHC	3	7.4E-07	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.7E-07	1.3E+01	7.4E-07	1.3E+01	N/A	--	208.0	--	--	1.3E-03	1HR
HCCGC	3	1.8E-07	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-07	1.3E+01	N/A	--	38.4	--	--	1.1E-01	1HR
HCCHC	3	1.8E-07	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.9E-08	1.3E+01	1.8E-07	1.3E+01	N/A	--	76.8	--	--	1.3E-03	1HR
HCMVC	3	1.4E-06	1.3E+01	N/A	--	N/A	--	N/A	--	7.1E-07	1.3E+01	N/A	--	1.4E-06	1.3E+01	7.1E-07	1.3E+01	378.0	--	--	1.7E-05	1HR
HCPGC	3	1.0E-07	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01	52.0	--	--	2.4E-01	1HR
HCPHC	3	1.0E-07	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	5.0E-08	1.3E+01	1.0E-07	1.3E+01	N/A	--	93.6	--	--	2.1E-03	1HR
HCPVC	3	1.0E-07	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01	48.0	--	--	2.1E-05	1HR
HCQGC	3	1.0E-07	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01	87.0	--	--	5.6E-01	1HR
HCQVC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01	87.0	--	--	2.1E-05	1HR
HCRGC	3	5.3E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	5.3E-06	1.3E+01	2.6E-06	1.3E+01	160.5	--	--	4.5E-01	1HR
HCRVC	3	5.3E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	5.3E-06	1.3E+01	2.6E-06	1.3E+01	150.0	--	--	1.6E-05	1HR

File: HDLREGST.WK1   17-Aug-87   Page 2

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

		Accident Frequencies and Range Factors																	Agent Available and Released				
SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCSVC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.1E-07	1.3E+01	1.5E-07	1.3E+01	1356.0	--	--	2.7E-04	1HR
HCBGC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	1.7E-09	1.3E+01	440.0	--	--	4.3E+00	1HR
HCBHC	4	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.0E-10	1.3E+01	1.6E-09	1.3E+01	N/A	--	208.0	--	--	1.3E-03	1HR
HCCGC	4	3.9E-11	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-11	1.3E+01	N/A	--	38.4	--	--	1.1E-01	1HR
HCCHC	4	3.9E-11	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-11	1.3E+01	3.9E-11	1.3E+01	N/A	--	76.8	--	--	1.3E-03	1HR
HCKGC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	1.3E+01	N/A	--	1500.0	--	--	6.4E+00	1HR
HCKHC	4	1.4E-08	1.3E+01	6.7E-09	1.3E+01	N/A	--	N/A	--	6.7E-09	1.3E+01	N/A	--	1.4E-08	1.3E+01	7.2E-09	1.3E+01	1700.0	--	--	2.5E-02	1HR
HCKVC	4	1.4E-08	1.3E+01	N/A	--	N/A	--	7.2E-09	1.3E+01	N/A	--	N/A	--	1.4E-08	1.3E+01	N/A	--	1600.0	--	--	2.7E-04	1HR
HCNVC	4	1.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	6.9E-10	1.3E+01	N/A	--	1.4E-09	1.3E+01	6.9E-10	1.3E+01	378.0	--	--	1.7E-05	1HR
HCPGC	4	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	52.0	--	--	--	--
HCPHC	4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HCPVC	4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	48.0	--	--	--	--
HCUGC	4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HCUVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HCRGC	4	6.2E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	6.2E-09	1.3E+01	3.1E-09	1.3E+01	160.5	--	--	4.5E-01	1HR
HCRVC	4	6.2E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	6.2E-09	1.3E+01	3.1E-09	1.3E+01	150.0	--	--	1.6E-05	1HR
HCSVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-08	1.3E+01	2.7E-08	1.3E+01	1356.0	--	--	2.7E-04	1HR
HCBGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.3E-09	1.3E+01	N/A	--	440.0	2.2E+02	--	--	1HR
HCBHS	5	6.3E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.3E-09	1.3E+01	N/A	--	208.0	6.0E+00	--	--	1HR
HCCGS	5	7.2E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	38.4	1.6E+00	--	--	1HR
HCCHS	5	7.2E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	76.8	3.2E+00	--	--	1HR
HCKGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--	1500.0	1.5E+03	--	--	1HR
HCKHS	5	1.3E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--	1700.0	1.7E+03	--	--	1HR
HCKVS	5	1.3E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--	1600.0	1.6E+03	--	--	1HR
HCNVS	5	8.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--	378.0	1.0E+01	--	--	1HR
HCPGS	5	1.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--	52.0	6.5E+00	--	--	1HR
HCPHS	5	1.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--	93.6	1.2E+01	--	--	1HR
HCPVS	5	1.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--	48.0	6.0E+00	--	--	1HR
HCUGS	5	1.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--	87.0	1.5E+01	--	--	1HR

File: HDLREGST.WK1   17-Aug-87   Page 3

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCQVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--	87.0	1.5E+01	--	--	1HR
HCRGS	5	4.9E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.9E-09	1.3E+01	N/A	--	160.5	1.1E+01	--	--	1HR
HCRVS	5	4.9E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.9E-09	1.3E+01	N/A	--	150.0	1.0E+01	--	--	1HR
HCSVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-07	1.3E+01	N/A	--	1356.0	1.4E+03	--	--	1HR
HCBGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.2E-11	3.1E+01	N/A	--	440.0	--	--	2.2E+01	10 MIN
HCBHF	6	1.9E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--	208.0	--	--	3.0E-01	10 MIN
HCCGF	6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	38.4	--	--	--	--
HCCHF	6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	76.8	--	--	--	--
HCKGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--	1500.0	--	--	1.5E+02	10 MIN
HCKHF	6	2.1E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--	1700.0	--	--	8.5E+01	10 MIN
HCKVF	6	2.1E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--	1600.0	--	--	4.0E+01	10 MIN
HCNVF	6	2.7E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-10	3.1E+01	N/A	--	378.0	--	--	2.6E-01	10 MIN
HCPGF	6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	52.0	--	--	--	--
HCPHF	6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HCPVF	6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	48.0	--	--	--	--
HCQGF	6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HCQVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HCRGF	6	1.6E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	3.1E+01	N/A	--	160.5	--	--	1.1E+00	10 MIN
HCRVF	6	1.6E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	3.1E+01	N/A	--	150.0	--	--	2.5E-01	10 MIN
HCSVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-09	3.1E+01	N/A	--	1356.0	--	--	3.4E+01	10 MIN
HCBGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.7E-09	1.3E+01	N/A	--	440.0	2.2E+02	--	--	1HR
HCBHS	7	1.1E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-08	1.3E+01	N/A	--	208.0	6.0E+00	--	--	1HR
HCCGS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	38.4	--	--	--	--
HCCHS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	76.8	--	--	--	--
HCKGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	1500.0	1.5E+03	--	--	1HR
HCKHS	7	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	1700.0	1.7E+03	--	--	1HR
HCKVS	7	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	1600.0	1.6E+03	--	--	1HR
HCNVS	7	1.6E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	1.3E+01	N/A	--	378.0	1.0E+01	--	--	1HR
HCPGS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	52.0	--	--	--	--

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCPHS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HCPVS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	48.0	--	--	--	--
HCBGS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HCBVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HCRGS	7	9.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-09	1.3E+01	N/A	--	160.5	1.1E+01	--	--	1HR
HCRVS	7	9.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-09	1.3E+01	N/A	--	150.0	1.0E+01	--	--	1HR
HCSVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-07	1.3E+01	N/A	--	1356.0	1.4E+03	--	--	1HR
HCBGS	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-08	1.3E+01	2.3E-08	1.3E+01	10560.0	2.2E+02	--	--	1HR
HCDHS	8	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	1.2E-08	1.3E+01	N/A	--	4608.0	6.0E+00	--	--	1HR
HCCGS	8	8.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.8E-09	1.3E+01	N/A	--	1843.2	1.6E+00	--	--	1HR
HCCHS	8	8.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.8E-09	1.3E+01	8.8E-09	1.3E+01	N/A	--	3686.4	3.2E+00	--	--	1HR
HCKGS	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--	12000.0	1.5E+03	--	--	1HR
HCKHS	8	2.2E-08	1.3E+01	2.2E-08	1.3E+01	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--	2.2E-08	1.3E+01	2.2E-08	1.3E+01	13600.0	1.7E+03	--	--	1HR
HCKVS	8	2.2E-08	1.3E+01	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--	12000.0	1.6E+03	--	--	1HR
HCMVS	8	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	1.2E-08	1.3E+01	1.2E-08	1.3E+01	4536.0	1.0E+01	--	--	1HR
HCPGS	8	1.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01	3120.0	6.5E+00	--	--	1HR
HCPHS	8	1.0E-08	1.3E+01	N/A	--	1.0E-08	1.3E+01	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01	N/A	--	5616.0	1.2E+01	--	--	1HR
HCPVS	8	1.0E-08	1.3E+01	N/A	--	1.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01	2880.0	6.0E+00	--	--	1HR
HCDGS	8	1.0E-08	1.3E+01	N/A	--	1.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01	3480.0	1.5E+01	--	--	1HR
HCDVS	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01	3480.0	1.5E+01	--	--	1HR
HCRGS	8	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	1.3E-08	1.3E+01	2568.0	1.1E+01	--	--	1HR
HCRVS	8	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	1.3E-08	1.3E+01	2400.0	1.0E+01	--	--	1HR
HCSVS	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.5E-09	1.3E+01	8.5E-09	1.3E+01	5424.0	1.4E+03	--	--	1HR
HCBGF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-10	3.1E+01	8.6E-10	3.1E+01	10560.0	--	--	2.2E+01	10 MIN
HCDHF	9	5.4E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-10	3.1E+01	5.4E-10	3.1E+01	N/A	--	4608.0	--	--	3.0E-01	10 MIN
HCCGF	9	2.6E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-10	3.1E+01	N/A	--	1843.2	--	--	1.6E-01	10 MIN
HCCHF	9	2.6E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-10	3.1E+01	2.6E-10	3.1E+01	N/A	--	3686.4	--	--	1.6E-01	10 MIN
HCKGF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--	12000.0	--	--	1.5E+02	10 MIN
HCKHF	9	6.9E-10	3.1E+01	6.9E-10	3.1E+01	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--	6.9E-10	3.1E+01	6.9E-10	3.1E+01	13600.0	--	--	8.5E+01	10 MIN

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCXVF	9	6.9E-10	3.1E+01	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--	12000.0	--	--	4.0E+01	10 MIN
HCMVF	9	5.3E-10	3.1E+01	N/A	--	N/A	--	N/A	--	5.3E-10	3.1E+01	N/A	--	5.3E-10	3.1E+01	5.3E-10	3.1E+01	4536.0	--	--	2.6E-01	10 MIN
HCPGF	9	1.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01	3120.0	--	--	6.5E-01	10 MIN
HCPHF	9	1.2E-10	3.1E+01	N/A	--	1.2E-10	3.1E+01	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01	N/A	--	5616.0	--	--	5.0E-01	10 MIN
HCPVF	9	1.2E-10	3.1E+01	N/A	--	1.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01	2000.0	--	--	1.5E-01	10 MIN
HCOGF	9	1.2E-10	3.1E+01	N/A	--	1.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01	3400.0	--	--	1.5E+00	10 MIN
HCOVF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01	3400.0	--	--	3.6E-01	10 MIN
HCRGF	9	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	5.6E-10	3.1E+01	2560.0	--	--	1.1E+00	10 MIN
HCRVF	9	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	5.6E-10	3.1E+01	2400.0	--	--	2.5E-01	10 MIN
HCSVF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-10	3.1E+01	2.7E-10	3.1E+01	5424.0	--	--	3.4E+01	10 MIN
HCDGS	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-08	1.3E+01	1.1E-08	1.3E+01	10560.0	2.2E+02	--	--	1HR
HCDHS	10	6.9E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	6.9E-09	1.3E+01	6.9E-09	1.3E+01	N/A	--	4600.0	6.0E+00	--	--	1HR
HCCGS	10	3.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	N/A	--	1043.2	1.6E+00	--	--	1HR
HCCHS	10	3.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	3.4E-09	1.3E+01	N/A	--	3606.4	3.2E+00	--	--	1HR
HCXGS	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.0E-09	1.3E+01	N/A	--	12000.0	1.5E+03	--	--	1HR
HCKHS	10	8.0E-09	1.3E+01	8.0E-09	1.3E+01	N/A	--	N/A	--	8.0E-09	1.3E+01	N/A	--	8.0E-09	1.3E+01	8.0E-09	1.3E+01	13600.0	1.7E+03	--	--	1HR
HCKVS	10	8.0E-09	1.3E+01	N/A	--	N/A	--	8.0E-09	1.3E+01	N/A	--	N/A	--	8.0E-09	1.3E+01	N/A	--	12000.0	1.6E+03	--	--	1HR
HCMVS	10	6.0E-09	1.3E+01	N/A	--	N/A	--	N/A	--	6.0E-09	1.3E+01	N/A	--	6.0E-09	1.3E+01	6.0E-09	1.3E+01	4536.0	1.0E+01	--	--	1HR
HCPGS	10	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01	3120.0	6.5E+00	--	--	1HR
HCPHS	10	1.6E-09	1.3E+01	N/A	--	1.6E-09	1.3E+01	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01	N/A	--	5616.0	1.2E+01	--	--	1HR
HCPVS	10	1.6E-09	1.3E+01	N/A	--	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01	2000.0	6.0E+00	--	--	1HR
HCOGS	10	1.6E-09	1.3E+01	N/A	--	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01	3400.0	1.5E+01	--	--	1HR
HCOVS	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01	3400.0	1.5E+01	--	--	1HR
HCRGS	10	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	7.2E-09	1.3E+01	2560.0	1.1E+01	--	--	1HR
HCRVS	10	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	7.2E-09	1.3E+01	2400.0	1.0E+01	--	--	1HR
HCSVS	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-09	1.3E+01	3.5E-09	1.3E+01	5424.0	1.4E+03	--	--	1HR
HCDHC	11	5.8E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-09	2.6E+01	5.8E-09	2.6E+01	N/A	--	208.0	--	6.0E+00	1.3E-03	1 HR
HCCDC	11	2.9E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-09	2.6E+01	N/A	--	38.4	--	1.6E+00	1.6E-01	1 HR
HCCHC	11	2.9E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-09	2.6E+01	2.9E-09	2.6E+01	N/A	--	76.8	--	3.2E+00	8.0E-04	1 HR

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCNVC	11	4.3E-09	2.6E+01	N/A	--	N/A	--	N/A	--	2.2E-09	2.6E+01	N/A	--	4.3E-09	2.6E+01	2.2E-09	2.6E+01	378.0	--	3.2E+01	4.2E-05	1 HR
HCPGC	11	9.6E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-10	2.6E+01	4.8E-10	2.6E+01	52.0	--	6.5E+00	1.1E-01	1 HR
HCPNC	11	9.6E-10	2.6E+01	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	4.8E-10	2.6E+01	9.6E-10	2.6E+01	N/A	--	93.6	--	1.2E+01	7.0E-04	1 HR
HCPVC	11	9.6E-10	2.6E+01	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	N/A	--	9.6E-10	2.6E+01	4.8E-10	2.6E+01	48.0	--	6.0E+00	1.0E-05	1 HR
HCDGC	11	7.2E-10	2.6E+01	N/A	--	3.6E-10	2.6E+01	N/A	--	N/A	--	N/A	--	7.2E-10	2.6E+01	3.6E-10	2.6E+01	87.0	--	1.5E+01	1.7E-01	1 HR
HCDVC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	2.6E+01	3.6E-10	2.6E+01	87.0	--	1.5E+01	6.0E-06	1 HR
HCRGC	11	1.8E-09	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	1.8E-09	2.6E+01	9.0E-10	2.6E+01	160.5	--	2.1E+01	1.0E+00	1 HR
HCRVC	11	1.8E-09	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	1.8E-09	2.6E+01	9.0E-10	2.6E+01	150.0	--	2.0E+01	5.0E-06	1 HR
HCDNC	12	4.1E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	2.6E+01	4.1E-10	2.6E+01	N/A	--	200.0	--	6.0E+00	1.3E-03	1 HR
HCCGC	12	2.1E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	2.6E+01	N/A	--	38.4	--	1.6E+00	1.6E-01	1 HR
HCCNC	12	2.1E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	2.6E+01	2.1E-10	2.6E+01	N/A	--	76.8	--	3.2E+00	8.0E-04	1 HR
HCNVC	12	3.1E-10	2.6E+01	N/A	--	N/A	--	N/A	--	1.5E-10	2.6E+01	N/A	--	3.1E-10	2.6E+01	1.5E-10	2.6E+01	378.0	--	3.2E+01	4.2E-05	1 HR
HCPGC	12	6.9E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.9E-11	2.6E+01	3.4E-11	2.6E+01	52.0	--	6.5E+00	1.1E-01	1 HR
HCPNC	12	6.9E-11	2.6E+01	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	3.4E-11	2.6E+01	6.9E-11	2.6E+01	N/A	--	93.6	--	1.2E+01	7.0E-04	1 HR
HCPVC	12	6.9E-11	2.6E+01	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.9E-11	2.6E+01	3.4E-11	2.6E+01	48.0	--	6.0E+00	1.0E-05	1 HR
HCDGC	12	5.2E-11	2.6E+01	N/A	--	2.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	5.2E-11	2.6E+01	2.6E-11	2.6E+01	87.0	--	1.5E+01	1.7E-01	1 HR
HCDVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-11	2.6E+01	2.6E-11	2.6E+01	87.0	--	1.5E+01	6.0E-06	1 HR
HCRGC	12	1.3E-10	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	1.3E-10	2.6E+01	6.5E-11	2.6E+01	160.5	--	2.1E+01	1.0E+00	1 HR
HCRVC	12	1.3E-10	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	1.3E-10	2.6E+01	6.5E-11	2.6E+01	150.0	--	2.0E+01	5.0E-06	1 HR
HCDGC	17	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E-13	2.6E+01	6.0E-13	2.6E+01	440.0	--	--	1.3E-03	1HR
HCRGC	17	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	6.0E-13	2.6E+01	160.5	--	--	1.4E-01	1HR
HCRVC	17	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	6.0E-13	2.6E+01	150.0	--	--	4.7E-06	1HR
HCDGC	18	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-12	2.6E+01	1.2E-12	2.6E+01	220.0	--	--	7.8E-01	1HR
HCRGC	18	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	1.2E-12	2.6E+01	10.7	--	--	1.4E-01	1HR
HCRVC	18	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.[illegible]E-12	2.6E+01	1.[illegible]-12	2.6E+01	10.0	--	--	4.7E-06	1HR
HCDGC	19	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.[illegible]-15	3.1E+01	2.6E-15	3.1E+01	440.0	--	--	7.8E-01	1HR
HCRGC	19	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-[illegible]	3.1E+01	2.6E-14	3.1E+01	160.5	--	--	1.4E-01	1HR
HCRVC	19	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	[illegible].1E+01	2.6E-14	3.1E+01	150.0	--	--	4.7E-06	1HR
HCDGC	21	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-18	[illegible].1E+01	3.4E-18	3.1E+01	220.0	--	--	7.8E-01	1HR

File: HDLREGGT.WK1   17-Aug-87   Page 7

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	OP. NO.	AAAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCRGC	21	3.1E-10	3.1E+01	N/A	--	3.1E-10	3.1E+01	N/A	--	3.1E-10	3.1E+01	N/A	--	3.1E-10	3.1E+01	3.1E-10	3.1E+01	10.7	--	--	1.4E-01	1HR
HCRVC	21	3.1E-10	3.1E+01	N/A	--	3.1E-10	3.1E+01	N/A	--	3.1E-10	3.1E+01	N/A	--	3.1E-10	3.1E+01	3.1E-10	3.1E+01	10.0	--	--	4.7E-06	1HR
HCDHC	22	8.7E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.7E-11	2.6E+01	N/A	--	288.0	3.0E+01	6.0E+00	--	1HR
HCCGC	22	4.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--	38.4	8.0E+00	1.6E+00	--	1HR
HCCHC	22	4.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--	76.8	1.6E+01	3.2E+00	--	1HR
HCMVC	22	6.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	378.0	3.5E+02	3.2E+01	--	1HR
HCPGC	22	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--	52.0	3.2E+01	6.5E+00	--	1HR
HCPHC	22	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--	93.6	5.8E+01	1.2E+01	--	1HR
HCPVC	22	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--	48.0	3.0E+01	6.0E+00	--	1HR
HCBGC	22	1.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	87.0	7.3E+01	1.5E+01	--	1HR
HCQVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	87.0	7.3E+01	1.5E+01	--	1HR
HCRGC	22	2.7E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-11	2.6E+01	N/A	--	160.5	1.4E+02	2.1E+01	--	1HR
HCRVC	22	2.7E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-11	2.6E+01	N/A	--	150.0	1.3E+02	2.0E+01	--	1HR
HCDHC	23	2.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-11	2.6E+01	2.3E-11	2.6E+01	N/A	--	1152.0	3.0E+01	6.0E+00	--	1HR
HCCGC	23	3.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-11	2.6E+01	N/A	--	460.8	8.0E+00	1.6E+00	--	1HR
HCCHC	23	3.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-11	2.6E+01	3.5E-11	2.6E+01	N/A	--	921.6	1.6E+01	3.2E+00	--	1HR
HCMVC	23	1.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.3E-11	2.6E+01	N/A	--	1.3E-11	2.6E+01	1.3E-11	2.6E+01	1134.0	3.5E+02	3.2E+01	--	1HR
HCPGC	23	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01	780.0	3.2E+01	6.5E+00	--	1HR
HCPHC	23	1.4E-11	2.6E+01	N/A	--	1.4E-11	2.6E+01	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01	N/A	--	1404.0	5.8E+01	1.2E+01	--	1HR
HCPVC	23	1.4E-11	2.6E+01	N/A	--	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01	720.0	3.0E+01	6.0E+00	--	1HR
HCBGC	23	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01	870.0	7.3E+01	1.5E+01	--	1HR
HCQVC	23	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01	870.0	7.3E+01	1.5E+01	--	1HR
HCRGC	23	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01	642.0	1.4E+02	2.1E+01	--	1HR
HCRVC	23	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01	600.0	1.3E+02	2.0E+01	--	1HR
HCDHC	24	6.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.2E-11	2.6E+01	N/A	--	288.0	3.0E+01	6.0E+00	--	1HR
HCCGC	24	3.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	2.6E+01	N/A	--	38.4	8.0E+00	1.6E+00	--	1HR
HCCHC	24	3.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	2.6E+01	N/A	--	76.8	1.6E+01	3.2E+00	--	1HR
HCMVC	24	4.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.6E-11	2.6E+01	N/A	--	378.0	3.5E+02	3.2E+01	--	1HR
HCPGC	24	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--	52.0	3.2E+01	6.5E+00	--	1HR

File: HDLREGS1.WK1   17-Aug-87   Page 8

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCPHC	24	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--	93.6	5.8E+01	1.2E+01	--	1HR
HCPVC	24	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--	48.0	3.0E+01	6.0E+00	--	1HR
HCQGC	24	7.7E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	87.0	7.3E+01	1.5E+01	--	1HR
HCQVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	87.0	7.3E+01	1.5E+01	--	1HR
HCRGC	24	1.9E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-11	2.6E+01	N/A	--	160.5	1.4E+02	2.1E+01	--	1HR
HCRVC	24	1.9E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-11	2.6E+01	N/A	--	150.0	1.3E+02	2.0E+01	--	1HR
HCMHC	25	1.7E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	2.6E+01	1.7E-11	2.6E+01	N/A	--	1152.0	3.0E+01	6.0E+00	--	1HR
HCCGC	25	2.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.5E-11	2.6E+01	N/A	--	460.8	8.0E+00	1.6E+00	--	1HR
HCCHC	25	2.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.5E-11	2.6E+01	2.5E-11	2.6E+01	N/A	--	921.6	1.6E+01	3.2E+00	--	1HR
HCMVC	25	9.3E-12	2.6E+01	N/A	--	N/A	--	N/A	--	9.3E-12	2.6E+01	N/A	--	9.3E-12	2.6E+01	9.3E-12	2.6E+01	1134.0	3.5E+02	3.2E+01	--	1HR
HCPGC	25	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01	780.0	3.2E+01	6.5E+00	--	1HR
HCPHC	25	1.0E-11	2.6E+01	N/A	--	1.0E-11	2.6E+01	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01	N/A	--	1404.0	5.8E+01	1.2E+01	--	1HR
HCPVC	25	1.0E-11	2.6E+01	N/A	--	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01	720.0	3.0E+01	6.0E+00	--	1HR
HCQGC	25	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01	870.0	7.3E+01	1.5E+01	--	1HR
HCQVC	25	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01	870.0	7.3E+01	1.5E+01	--	1HR
HCRGC	25	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01	642.0	1.4E+02	2.1E+01	--	1HR
HCRVC	25	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01	600.0	1.3E+02	2.0E+01	--	1HR
HCDGF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	440.0	--	--	--	--
HCDHC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	288.0	--	--	--	--
HCCGC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	38.4	--	--	--	--
HCCHC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	76.8	--	--	--	--
HCKGF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	1500.0	--	--	--	--
HCKHF	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	1700.0	--	--	--	--
HCKVF	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	1600.0	--	--	--	--
HCMVC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	378.0	--	--	--	--
HCPGC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	52.0	--	--	--	--
HCPHC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HCPVC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	48.0	--	--	--	--
HCQGC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--

File: HDLREGST.WK1 17-Aug-87 Page 9

HANDLING ACCIDENTS - REGIONAL PROCESSING OPTION - PER PALLET

Accident Frequencies and Range Factors / Agent Available and Released

SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCDVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HCRGC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	160.5	--	--	--	--
HCRVC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	150.0	--	--	--	--
HCSVF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	1356.0	--	--	--	--
HCBGF	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	2640.0	--	--	--	--
HCDMC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	1152.0	--	--	--	--
HCCGC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	440.0	--	--	--	--
HCCMC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	921.6	--	--	--	--
HCKGF	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	3000.0	--	--	--	--
HCKMF	27	0.0E+00	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	3400.0	--	--	--	--
HCKVF	27	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	3200.0	--	--	--	--
HCMVC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	1134.0	--	--	--	--
HCPGC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	780.0	--	--	--	--
HCPMC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	1404.0	--	--	--	--
HCPVC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	720.0	--	--	--	--
HCQGC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	870.0	--	--	--	--
HCQVC	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	870.0	--	--	--	--
HCRGC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	642.0	--	--	--	--
HCRVC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	600.0	--	--	--	--
HCSVF	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	1356.0	--	--	--	--
HCRGC	29	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	9.0E-09	2.6E+01	160.5	--	2.1E+01	7.1E-02	1 HR
HCRVC	29	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	9.0E-09	2.6E+01	150.0	--	2.0E+01	1.0E-03	1 HR
HCRGC	30	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	1.8E-08	2.6E+01	10.7	--	1.1E+01	--	INST
HCRVC	30	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	1.8E-08	2.6E+01	10.0	--	1.0E+01	--	INST
HCRGC	31	6.5E-11	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	6.5E-11	2.6E+01	1.3E-10	2.6E+01	642.0	1.4E+02	2.1E+01	--	1HR
HCRVC	31	6.5E-11	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	6.5E-11	2.6E+01	1.3E-10	2.6E+01	600.0	1.3E+02	2.0E+01	--	1HR
HCBGS	32	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-03	1.0E+01	1.0E-03	1.0E+01	220.0	--	--	NEGL	--
HCRGS	32	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	1.0E-03	1.0E+01	10.7	--	--	NEGL	--
HCRVS	32	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	1.0E-03	1.0E+01	10.0	--	--	NEGL	--

Page 1 Date 21-Aug-87

ONSITE TRANSPORTATION - BARGE

Scenario Frequencies and Range Factors Agent Available and Released

SCENARIO	NO.	APG FREQ	RANGE FACTOR	AGENT AVAIL	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VWKHS	1	0.0E+00	--	3400.0	--	--	--	--
VWKHS	2	0.0E+00	--	3400.0	--	--	--	--
VWKHS	3	2.7E-11	26	3400.0	1.7E+03	--	--	2 HRS
VWKHF	5	0.0E+00	--	3400.0	--	--	--	--
VWKHS	6	2.3E-07	20	3400.0	2.9E+03	--	--	1 HR
VWKHF	7	1.9E-07	20	3400.0	--	--	8.5E+01	20 MIN
VWKHS	9	0.0E+00	--	3400.0	--	--	--	--
VWKHS	10	0.0E+00	--	3400.0	--	--	--	--
VWKHS	11	1.2E-09	14	3400.0	1.7E+03	--	--	2 HRS
VWKHF	13	0.0E+00	--	3400.0	--	--	--	--
VWKHF	14	1.1E-09	24	3400.0	1.7E+03	--	--	2 HRS

File: HFREG.WK1 Page 1 Date 20-Aug-87

REGIONAL COLLOCATION OPTION - FACILITY HANDLING

		Accident Frequencies for Facility Handling Operations (HF, (Events per Pallet or Container)																Agent Available and Released				
	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HFBGS	1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E-09	1.3E+01	N/A	--	440.0	220.0	--	--	1hr
HFDHS	1	4.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E-09	1.3E+01	N/A	--	288.0	6.0	--	--	1hr
HFCGS	1	4.8E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-10	1.3E+01	N/A	--	48.0	1.6	--	--	1hr
HFCHS	1	4.8E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-10	1.3E+01	N/A	--	96.0	3.2	--	--	1hr
HFKGS	1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--	1500.0	1500.0	--	--	1hr
HFKHS	1	8.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--	1700.0	1700.0	--	--	1hr
HFKVS	1	8.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--	1600.0	1600.0	--	--	1hr
HFMVS	1	5.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.8E-09	1.3E+01	N/A	--	378.0	10.5	--	--	1hr
HFPGS	1	7.2E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	52.0	6.5	--	--	1hr
HFPHS	1	7.2E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	93.6	11.7	--	--	1hr
HFPVS	1	7.2E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	48.0	6.0	--	--	1hr
HFQGS	1	7.2E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	87.0	14.5	--	--	1hr
HFQVS	1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	87.0	14.5	--	--	1hr
HFRGS	1	3.2E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	1.3E+01	N/A	--	160.5	10.7	--	--	1hr
HFRVS	1	3.2E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	1.3E+01	N/A	--	150.0	10.0	--	--	1hr
HFSVS	1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-06	1.3E+01	N/A	--	1356.0	1356.0	--	--	1hr
HFBGC	2	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-16	3.1E+01	N/A	--	220.0	--	--	NEGL	--
HFDHC	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	6.0	--	--	--	--
HFCGC	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	1.6	--	--	--	--
HFCHC	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	3.2	--	--	--	--
HFKGC	2	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.4E-16	3.1E+01	N/A	--	1500.0	--	--	NEGL	--
HFKHC	2	8.4E-16	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.4E-16	3.1E+01	N/A	--	1700.0	--	--	NEGL	--
HFKVC	2	8.4E-16	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.4E-16	3.1E+01	N/A	--	1600.0	--	--	NEGL	--
HFMVC	2	2.6E-17	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-17	3.1E+01	N/A	--	10.5	--	--	NEGL	--
HFPGC	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	6.5	--	--	--	--
HFPHC	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	11.7	--	--	--	--
HFPVC	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	6.0	--	--	--	--
HFQGS	2	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	14.5	--	--	--	--
HFQVS	2	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	14.5	--	--	--	--

File: HFREG.WK1 Page 2 Date 20-Aug-87

REGIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container) — Agent Available and Released

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HFRGC	2	1.8E-16	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-16	3.1E+01	N/A	--	10.7	--	--	NEGL	--
HFRVC	2	1.8E-16	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-16	3.1E+01	N/A	--	10.0	--	--	NEGL	--
HFSVC	2	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.5E-15	3.1E+01	N/A	--	1356.0	--	--	NEGL	--
HFBGF	3	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	3.1E+01	N/A	--	440.0	--	--	2.20E+01	10min
HFBHF	3	9.4E-11	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.4E-11	3.1E+01	N/A	--	288.0	--	--	3.00E-01	10min
HFCGF	3	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	--	--
HFCHF	3	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	96.0	--	--	--	--
HFKGF	3	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	3.1E+01	N/A	--	1500.0	--	--	1.50E+02	10min
HFKHF	3	1.0E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	3.1E+01	N/A	--	1700.0	--	--	8.50E+01	10min
HFKVF	3	1.0E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	3.1E+01	N/A	--	1600.0	--	--	4.00E+01	10min
HFMVF	3	1.4E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-10	3.1E+01	N/A	--	378.0	--	--	2.63E-01	10min
HFPGF	3	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	52.0	--	--	--	--
HFPHF	3	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	93.6	--	--	--	--
HFPVF	3	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	--	--
HFQGF	3	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	--	--
HFQVF	3	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	--	--
HFRGF	3	8.1E-11	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.1E-11	3.1E+01	N/A	--	160.5	--	--	1.07E+00	10min
HFRVF	3	8.1E-11	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.1E-11	3.1E+01	N/A	--	150.0	--	--	2.50E-01	10min
HFSVF	3	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-09	3.1E+01	N/A	--	1356.0	--	--	3.39E+01	10min
HFSVS	4	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-07	1.3E+01	N/A	--	1356.0	--	--	9.00E-05	1hr
HFBGF	5	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	288.0	--	--	--	--
HFDHC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	288.0	--	--	--	--
HFCGC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	--	--
HFCHC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	96.0	--	--	--	--
HFKGF	5	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	1500.0	--	--	--	--
HFKHF	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	1700.0	--	--	--	--
HFKVF	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	1600.0	--	--	--	--
HFMVC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	378.0	--	--	--	--
HFPGC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	52.0	--	--	--	--

File: HFREG.WK1 Page 3 Date 20-Aug-87

REGIONAL COLLOCATION OPTION - FACILITY HANDLING

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
	Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)																	Agent Available and Released				
HFPHC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	93.6	--	--	--	--
HFPVC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	--	--
HFQGC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	--	--
HFQVC	5	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	--	--
HFRGC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	160.5	--	--	--	--
HFRVC	5	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	150.0	--	--	--	--
HFSVF	5	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	1356.0	--	--	--	--
HFBGS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.3E-10	1.3E+01	N/A	--	440.0	220.0	--	--	1hr
HFDHS	7	2.5E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.5E-09	1.3E+01	N/A	--	288.0	6.0	--	--	1hr
HFCGS	7	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	--	--
HFCHS	7	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	96.0	--	--	--	--
HFKGS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-09	1.3E+01	N/A	--	1500.0	1500.0	--	--	1hr
HFKHS	7	2.7E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-09	1.3E+01	N/A	--	1700.0	1700.0	--	--	1hr
HFKVS	7	2.7E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-09	1.3E+01	N/A	--	1600.0	1600.0	--	--	1hr
HFMVS	7	3.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-09	1.3E+01	N/A	--	378.0	10.5	--	--	1hr
HFPGS	7	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	52.0	--	--	--	--
HFPHS	7	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	93.6	--	--	--	--
HFPVS	7	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	--	--
HFQGS	7	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	--	--
HFQVS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	--	--
HFRGS	7	2.2E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	1.3E+01	N/A	--	160.5	10.7	--	--	1hr
HFRVS	7	2.2E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	1.3E+01	N/A	--	150.0	10.0	--	--	1hr
HFSVS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	1.3E+01	N/A	--	1356.0	1356.0	--	--	1hr
HFBGC	8	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.3E-18	3.1E+01	N/A	--	220.0	--	--	NEGL	--
HFDHC	8	5.3E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.3E-18	3.1E+01	N/A	--	6.0	--	--	NEGL	--
HFCGC	8	6.0E-19	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E-19	3.1E+01	N/A	--	1.6	--	--	NEGL	--
HFCHC	8	6.0E-19	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E-19	3.1E+01	N/A	--	3.2	--	--	NEGL	--
HFKGC	8	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-17	3.1E+01	N/A	--	1500.0	--	--	NEGL	--
HFKHC	8	1.1E-17	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-17	3.1E+01	N/A	--	1700.0	--	--	NEGL	--

File: HFREG.WK1 Page 4 Date 20-Aug-87

REGIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container) — Agent Available and Released

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HFKVC	8	1.1E-17	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-17	3.1E+01	N/A	--	1600.0	--	--	NEGL	--
HFMVC	8	7.2E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-18	3.1E+01	N/A	--	10.5	--	--	NEGL	--
HFPGC	8	9.0E-19	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--	6.5	--	--	NEGL	--
HFPHC	8	9.0E-19	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--	11.7	--	--	NEGL	--
HFPVC	8	9.0E-19	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--	6.0	--	--	NEGL	--
HFQGC	8	9.0E-19	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--	14.5	--	--	NEGL	--
HFQVC	8	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--	14.5	--	--	NEGL	--
HFRGC	8	4.1E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-18	3.1E+01	N/A	--	10.7	--	--	NEGL	--
HFRVC	8	4.1E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-18	3.1E+01	N/A	--	10.0	--	--	NEGL	--
HFSVC	8	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-15	3.1E+01	N/A	--	1356.0	--	--	NEGL	--
HFSVC	9	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-16	3.1E+01	N/A	--	1356.0	--	--	1.35E-04	1hr
HFBGC	10	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-19	3.1E+01	N/A	--	440.0	--	--	NEGL	--
HFDHC	10	1.3E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-18	3.1E+01	N/A	--	288.0	--	--	NEGL	--
HFCGC	10	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	NEGL	--
HFCHC	10	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	96.0	--	--	NEGL	--
HFKGC	10	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-18	3.1E+01	N/A	--	1500.0	--	--	NEGL	--
HFKHC	10	1.4E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-18	3.1E+01	N/A	--	1700.0	--	--	NEGL	--
HFKVC	10	1.4E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-18	3.1E+01	N/A	--	1600.0	--	--	NEGL	--
HFMVC	10	1.9E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-18	3.1E+01	N/A	--	378.0	--	--	NEGL	--
HFPGC	10	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	52.0	--	--	NEGL	--
HFPHC	10	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	93.6	--	--	NEGL	--
HFPVC	10	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	NEGL	--
HFQGC	10	0.0E+00		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	NEGL	--
HFQVC	10	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	NEGL	--
HFRGC	10	1.1E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-18	3.1E+01	N/A	--	160.5	--	--	NEGL	--
HFRVC	10	1.1E-18	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-18	3.1E+01	N/A	--	150.0	--	--	NEGL	--
HFSVC	10	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-17	3.1E+01	N/A	--	1356.0	--	--	NEGL	--
HFDHC	11	5.8E-11	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.8E-11	2.6E+01	N/A	--	288.0	30.0	6.0	--	1hr
HFCGC	11	2.9E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-11	2.6E+01	N/A	--	48.0	8.0	1.6	--	1hr

File: HFREG.WK1 Page 5 Date 20-Aug-87

REGIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container) — Agent Available and Released

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HFCHC	11	2.9E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-11	2.6E+01	N/A	--	96.0	16.0	3.2	--	1hr
HFMVC	11	4.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--	378.0	157.5	31.5	--	1hr
HFPBC	11	9.6E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-12	2.6E+01	N/A	--	52.0	32.5	6.5	--	1hr
HFPHC	11	9.6E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-12	2.6E+01	N/A	--	93.6	58.5	11.7	--	1hr
HFPVC	11	9.6E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-12	2.6E+01	N/A	--	48.0	30.0	6.0	--	1hr
HFQGC	11	7.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	N/A	--	87.0	72.5	14.5	--	1hr
HFQVC	11	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	N/A	--	87.0	72.5	14.5	--	1hr
HFRGC	11	1.8E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-11	2.6E+01	N/A	--	160.5	139.1	21.4	--	1hr
HFRVC	11	1.8E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-11	2.6E+01	N/A	--	150.0	130.0	20.0	--	1hr
HFDHC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	6.0	--	6.0	--	INSTANT
HFCGC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	1.6	--	1.6	--	INSTANT
HFCHC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	3.2	--	3.2	--	INSTANT
HFMVC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	10.5	--	10.5	--	INSTANT
HFPGC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	6.5	--	6.5	--	INSTANT
HFPHC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	11.7	--	11.7	--	INSTANT
HFPVC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	6.0	--	6.0	--	INSTANT
HFQGC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	14.5	--	14.5	--	INSTANT
HFQVC	12	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	14.5	--	14.5	--	INSTANT
HFRGC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	10.7	--	10.7	--	INSTANT
HFRVC	12	3.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	10.0	--	10.0	--	INSTANT
HFDHC	13	7.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-11	2.6E+01	N/A	--	288.0	--	6.0	1.70E-03	1hr
HFCGC	13	3.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-11	2.6E+01	N/A	--	48.0	--	1.6	3.70E-01	1hr
HFCHC	13	3.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-11	2.6E+01	N/A	--	96.0	--	3.2	1.60E-03	1hr
HFMVC	13	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	378.0	--	31.5	3.30E-05	1hr
HFPGC	13	1.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-11	2.6E+01	N/A	--	52.0	--	6.5	3.90E-01	1hr
HFPHC	13	1.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-11	2.6E+01	N/A	--	93.6	--	11.7	1.90E-03	1hr
HFPVC	13	1.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-11	2.6E+01	N/A	--	48.0	--	6.0	6.00E-06	1hr
HFQGC	13	9.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-12	2.6E+01	N/A	--	87.0	--	14.5	4.50E-01	1hr
HFQVC	13	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-12	2.6E+01	N/A	--	87.0	--	14.5	1.40E-05	1hr

REGIONAL COLLOCATION OPTION - FACILITY HANDLING

		Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)																Agent Available and Released				
	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HFRGC	13	2.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--	160.5	--	21.4	9.80E-01	1hr
HFRVC	13	2.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--	150.0	--	20.0	2.90E-05	1hr
HFDHC	14	1.3E-14	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-14	2.6E+01	N/A	--	288.0	30.0	6.0	--	1hr
HFCGC	14	6.6E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.6E-15	2.6E+01	N/A	--	48.0	8.0	1.6	--	1hr
HFCHC	14	6.6E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.6E-15	2.6E+01	N/A	--	96.0	16.0	3.2	--	1hr
HFMVC	14	9.9E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.9E-15	2.6E+01	N/A	--	378.0	157.5	31.5	--	1hr
HFPGC	14	2.2E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-15	2.6E+01	N/A	--	52.0	32.5	6.5	--	1hr
HFPHC	14	2.2E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-15	2.6E+01	N/A	--	93.6	58.5	11.7	--	1hr
HFPVC	14	2.2E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-15	2.6E+01	N/A	--	48.0	30.0	6.0	--	1hr
HFQGC	14	1.7E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-15	2.6E+01	N/A	--	87.0	72.5	14.5	--	1hr
HFQVC	14	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-15	2.6E+01	N/A	--	87.0	72.5	14.5	--	1hr
HFRGC	14	4.1E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-15	2.6E+01	N/A	--	160.5	139.1	21.4	--	1hr
HFRVC	14	4.1E-15	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-15	2.6E+01	N/A	--	150.0	130.0	20.0	--	1hr

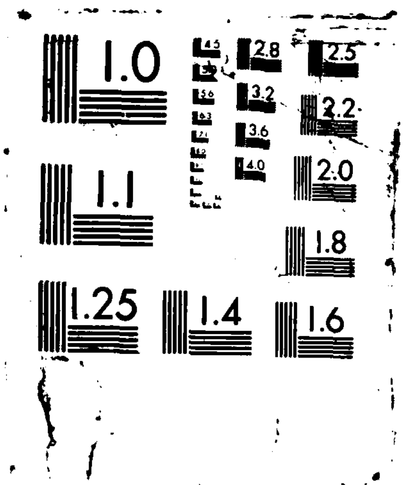
File: HDLNAT.WK1, Page 1 Date 18-Aug-87

HANDLING ACCIDENTS - NATIONAL P[illegible]CESSING OPTION - PER PALLET OR CONTAINER

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	OP. NO.	AMAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCBGC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-07	1.3E+01	6.1E-08	1.3E+01	440.0	--	--	4.3E+00	1HR
HCDHC	1	1.6E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	1.3E+01	3.2E-08	1.3E+01	N/A	--	288.0	--	--	1.3E-03	1HR
HCCGC	1	2.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.7E-09	1.3E+01	N/A	--	38.4	--	--	1.1E-01	1HR
HCCHC	1	2.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-09	1.3E+01	5.7E-09	1.3E+01	N/A	--	76.8	--	--	1.3E-03	1HR
HCKGC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.0E-08	1.3E+01	N/A	--	1500.0	--	--	6.4E+00	1HR
HCKHC	1	2.0E-08	1.3E+01	2.0E-08	1.3E+01	N/A	--	N/A	--	2.0E-08	1.3E+01	N/A	--	4.0E-08	1.3E+01	2.0E-08	1.3E+01	1700.0	--	--	2.5E-02	1HR
HCKVC	1	N/A	--	N/A	--	N/A	--	2.0E-08	1.3E+01	N/A	--	N/A	--	4.0E-08	1.3E+01	N/A	--	1600.0	--	--	2.7E-04	1HR
HCMVC	1	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	2.4E-08	1.3E+01	1.2E-08	1.3E+01	378.0	--	--	1.7E-05	1HR
HCPGC	1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	52.0	--	--	--	--
HCPHC	1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HCPVC	1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	48.0	--	--	--	--
HCQGC	1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HCQVC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HCRGC	1	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	9.5E-08	1.3E+01	4.8E-08	1.3E+01	160.5	--	--	4.5E-01	1HR
HCRVC	1	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	9.5E-08	1.3E+01	4.8E-08	1.3E+01	150.0	--	--	1.6E-05	1HR
HCSVC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-06	1.3E+01	5.2E-07	1.3E+01	1356.0	--	--	2.7E-04	1HR
HCKHF	2	N/A	--	5.2E-10	3.1E+01	N/A	--	N/A	--	5.2E-10	3.1E+01	N/A	--	5.2E-10	3.1E+01	N/A	--	1700.0	--	--	8.5E+01	10 MIN
HCBGC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-07	1.3E+01	1.3E-07	1.3E+01	440.0	--	--	4.3E+00	1HR
HCDHC	3	3.7E-07	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.7E-07	1.3E+01	7.4E-07	1.3E+01	N/A	--	288.0	--	--	1.3E-03	1HR
HCCGC	3	8.9E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-07	1.3E+01	N/A	--	38.4	--	--	1.1E-01	1HR
HCCHC	3	8.9E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.9E-08	1.3E+01	1.8E-07	1.3E+01	N/A	--	76.8	--	--	1.3E-03	1HR
HCMVC	3	7.1E-07	1.3E+01	N/A	--	N/A	--	N/A	--	7.1E-07	1.3E+01	N/A	--	1.4E-06	1.3E+01	7.1E-07	1.3E+01	378.0	--	--	1.7E-05	1HR
HCPGC	3	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01	52.0	--	--	2.4E-01	1HR
HCPHC	3	5.0E-08	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	5.0E-08	1.3E+01	1.0E-07	1.3E+01	N/A	--	93.6	--	--	2.1E-03	1HR
HCPVC	3	5.0E-08	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01	48.0	--	--	2.1E-05	1HR
HCQGC	3	5.0E-08	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01	87.0	--	--	5.6E-01	1HR
HCQVC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	5.0E-08	1.3E+01	87.0	--	--	2.1E-05	1HR
HCRGC	3	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	5.3E-06	1.3E+01	2.6E-06	1.3E+01	160.5	--	--	4.5E-01	1HR
HCRVC	3	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	5.3E-06	1.3E+01	2.6E-06	1.3E+01	150.0	--	--	1.6E-05	1HR

AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO CA A W BARSELL ET AL. AUG 87 GA-C-18563 12/13

UNCLASSIFIED SAPEO-CDE-IS-87008 DAAA15-85-D-0022 F/G 15/6.3 NL


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

File: HDLNAT.WK1, Page 2 Date 18-Aug-87

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

			Accident Frequencies and Range Factors																Agent Available and Released					
SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCSVC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.1E-07	1.3E+01	1.5E-07	1.3E+01	1356.0	--	--	2.7E-04	1HR
HCBGC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	1.7E-09	1.3E+01	440.0	--	--	4.3E+00	1HR
HCBHC	4	8.0E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.0E-10	1.3E+01	1.6E-09	1.3E+01	N/A	--	280.0	--	--	1.3E-03	1HR
HCCGC	4	2.0E-11	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-11	1.3E+01	N/A	--	38.4	--	--	1.1E-01	1HR
HCCHC	4	2.0E-11	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-11	1.3E+01	3.9E-11	1.3E+01	N/A	--	76.0	--	--	1.3E-03	1HR
HCKGC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	1.3E+01	N/A	--	1500.0	--	--	1.7E-05	1HR
HCLHC	4	7.2E-09	1.3E+01	6.7E-09	1.3E+01	N/A	--	N/A	--	6.7E-09	1.3E+01	N/A	--	1.4E-08	1.3E+01	7.2E-09	1.3E+01	1700.0	--	--	2.4E-01	1HR
HCKVC	4	N/A	--	N/A	--	N/A	--	7.2E-09	1.3E+01	N/A	--	N/A	--	1.4E-08	1.3E+01	N/A	--	1600.0	--	--	2.1E-03	1HR
HCMVC	4	6.9E-10	1.3E+01	N/A	--	N/A	--	N/A	--	6.9E-10	1.3E+01	N/A	--	1.4E-09	1.3E+01	6.9E-10	1.3E+01	378.0	--	--	2.1E-05	1HR
HCPGC	4	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		0.0E+00	--	52.0	--	--	--	--
HCPHC	4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00		N/A	--	93.6	--	--	--	--
HCPVC	4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00		0.0E+00	--	46.0	--	--	--	--
HCQGC	4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00		0.0E+00	--	87.0	--	--	--	--
HCQVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		0.0E+00	--	87.0	--	--	--	--
HCRGC	4	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	6.2E-09	1.3E+01	3.1E-09	1.3E+01	160.5	--	--	4.5E-01	1HR
HCRVC	4	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	6.2E-09	1.3E+01	3.1E-09	1.3E+01	150.0	--	--	1.6E-05	1HR
HCSVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-08	1.3E+01	2.7E-08	1.3E+01	1356.0	--	--	2.7E-04	1HR
HCBGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.3E-09	1.3E+01	N/A	--	440.0	2.2E+02	--	--	1HR
HCBHS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.3E-09	1.3E+01	N/A	--	280.0	6.0E+00	--	--	1HR
HCCGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	38.4	1.6E+00	--	--	1HR
HCCHS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	76.0	3.2E+00	--	--	1HR
HCKGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--	1500.0	1.5E+03	--	--	1HR
HCLHS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--	1700.0	1.7E+03	--	--	1HR
HCKVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--	1600.0	1.6E+03	--	--	1HR
HCMVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--	378.0	1.0E+01	--	--	1HR
HCPGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--	52.0	6.5E+00	--	--	1HR
HCPHS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--	93.6	1.2E+01	--	--	1HR
HCPVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--	48.0	6.0E+00	--	--	1HR
HCQGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--	87.0	1.5E+01	--	--	1HR

File: HDLNAT.WK1, Page 3 Date 18-Aug-87

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCDVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	N/A	--	87.0	1.5E+01	--	--	1HR
HCRGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.9E-09	1.3E+01	N/A	--	160.5	1.1E+01	--	--	1HR
HCRVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.9E-09	1.3E+01	N/A	--	150.0	1.0E+01	--	--	1HR
HCSVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-07	1.3E+01	N/A	--	1356.0	1.4E+03	--	--	1HR
HCBGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.2E-11	3.1E+01	N/A	--	440.0	--	--	2.2E+01	10 MIN
HCDHF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--	288.0	--	--	3.0E-01	10 MIN
HCCGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	38.4	--	--	--	--
HCCHF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	76.8	--	--	--	--
HCKGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--	1500.0	--	--	1.5E+02	10 MIN
HCKHF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--	1700.0	--	--	8.5E+01	10 MIN
HCKVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--	1600.0	--	--	4.0E+01	10 MIN
HCMVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-10	3.1E+01	N/A	--	378.0	--	--	2.6E-01	10 MIN
HCPGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	52.0	--	--	--	--
HCPHF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HCPVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	48.0	--	--	--	--
HCQGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HCQVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HCRGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	3.1E+01	N/A	--	160.5	--	--	1.1E+00	10 MIN
HCRVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	3.1E+01	N/A	--	150.0	--	--	2.5E-01	10 MIN
HCSVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-09	3.1E+01	N/A	--	1356.0	--	--	3.4E+01	10 MIN
HCBGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.7E-09	1.3E+01	N/A	--	440.0	2.2E+02	--	--	1HR
HCDHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-08	1.3E+01	N/A	--	288.0	6.0E+00	--	--	1HR
HCCGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	38.4	--	--	--	--
HCCHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	76.8	--	--	--	--
HCKGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	1500.0	1.5E+03	--	--	1HR
HCKHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	1700.0	1.7E+03	--	--	1HR
HCKVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	1600.0	1.6E+03	--	--	1HR
HCMVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	1.3E+01	N/A	--	378.0	1.0E+01	--	--	1HR
HCPGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	52.0	--	--	--	--

File: HDLNAT.WK1, Page 4 Date 18-Aug-87

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

		Accident Frequencies and Range Factors																		Agent Available and Released				
SCEN-ARIO	OP. NO.	AMAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCPHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HCPVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	48.0	--	--	--	--
HCQGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HCQVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HCRGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-09	1.3E+01	N/A	--	160.5	1.1E+01	--	--	1HR
HCRVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-09	1.3E+01	N/A	--	150.0	1.0E+01	--	--	1HR
HCSVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-07	1.3E+01	N/A	--	1356.0	1.4E+03	--	--	1HR
HCBGS	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-08	1.3E+01	2.3E-08	1.3E+01	10560.0	2.2E+02	--	--	1HR
HCDHS	8	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	1.2E-08	1.3E+01	N/A	--	4608.0	6.0E+00	--	--	1HR
HCCGS	8	8.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.8E-09	1.3E+01	N/A	--	1843.2	1.6E+00	--	--	1HR
HCCHS	8	8.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.8E-09	1.3E+01	8.8E-09	1.3E+01	N/A	--	3686.4	3.2E+00	--	--	1HR
HCKGS	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--	12000.0	1.5E+03	--	--	1HR
HCKHS	8	2.2E-08	1.3E+01	2.2E-08	1.3E+01	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--	2.2E-08	1.3E+01	2.2E-08	1.3E+01	13600.0	1.7E+03	--	--	1HR
HCKVS	8	N/A	--	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--	N/A	--	2.2E-08	1.3E+01	N/A	--	12000.0	1.6E+03	--	--	1HR
HCMVS	8	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	1.2E-08	1.3E+01	1.2E-08	1.3E+01	4536.0	1.0E+01	--	--	1HR
HCPGS	8	1.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01	3120.0	6.5E+00	--	--	1HR
HCPHS	8	1.0E-08	1.3E+01	N/A	--	1.0E-08	1.3E+01	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01	N/A	--	5616.0	1.2E+01	--	--	1HR
HCPVS	8	1.0E-08	1.3E+01	N/A	--	1.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01	2880.0	6.0E+00	--	--	1HR
HCQGS	8	1.0E-08	1.3E+01	N/A	--	1.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01	3480.0	1.5E+01	--	--	1HR
HCQVS	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	1.3E+01	1.0E-08	1.3E+01	3480.0	1.5E+01	--	--	1HR
HCRGS	8	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	1.3E-08	1.3E+01	2568.0	1.1E+01	--	--	1HR
HCRVS	8	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	N/A	--	1.3E-08	1.3E+01	1.3E-08	1.3E+01	2400.0	1.0E+01	--	--	1HR
HCSVS	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.5E-09	1.3E+01	8.5E-09	1.3E+01	5424.0	1.4E+03	--	--	1HR
HCBGF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-10	3.1E+01	8.6E-10	3.1E+01	10560.0	--	--	2.2E+01	10 MIN
HCDHF	9	5.4E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-10	3.1E+01	5.4E-10	3.1E+01	N/A	--	4608.0	--	--	3.0E-01	10 MIN
HCCGF	9	2.6E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-10	3.1E+01	N/A	--	1843.2	--	--	1.6E-01	10 MIN
HCCHF	9	2.6E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-10	3.1E+01	2.6E-10	3.1E+01	N/A	--	3686.4	--	--	1.6E-01	10 MIN
HCKGF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--	12000.0	--	--	1.5E+02	10 MIN
HCKHF	9	6.9E-10	3.1E+01	6.9E-10	3.1E+01	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--	6.9E-10	3.1E+01	6.9E-10	3.1E+01	13600.0	--	--	8.5E+01	10 MIN

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCXVF	9	N/A	--	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--	N/A	--	6.9E-10	3.1E+01	N/A	--	12000.0	--	--	4.0E+01	10 MIN
HCHVF	9	5.3E-10	3.1E+01	N/A	--	N/A	--	N/A	--	5.3E-10	3.1E+01	N/A	--	5.3E-10	3.1E+01	5.3E-10	3.1E+01	4536.0	--	--	2.6E-01	10 MIN
HCPGF	9	1.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01	3120.0	--	--	6.5E-01	10 MIN
HCPHF	9	1.2E-10	3.1E+01	N/A	--	1.2E-10	3.1E+01	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01	N/A	--	5616.0	--	--	5.0E-01	10 MIN
HCPVF	9	1.2E-10	3.1E+01	N/A	--	1.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01	2000.0	--	--	1.5E-01	10 MIN
HCBGF	9	1.2E-10	3.1E+01	N/A	--	1.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01	3400.0	--	--	1.5E+00	10 MIN
HCBVF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-10	3.1E+01	1.2E-10	3.1E+01	3400.0	--	--	3.6E-01	10 MIN
HCRGF	9	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	5.6E-10	3.1E+01	2560.0	--	--	1.1E+00	10 MIN
HCRVF	9	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	N/A	--	5.6E-10	3.1E+01	5.6E-10	3.1E+01	2400.0	--	--	2.5E-01	10 MIN
HCSVF	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-10	3.1E+01	2.7E-10	3.1E+01	5424.0	--	--	3.4E+01	10 MIN
HCBGS	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-08	1.3E+01	1.1E-08	1.3E+01	10560.0	2.2E+02	--	--	1HR
HCBHS	10	6.9E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	6.9E-09	1.3E+01	6.9E-09	1.3E+01	N/A	--	4608.0	6.0E+00	--	--	1HR
HCCGS	10	3.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	N/A	--	1843.2	1.6E+00	--	--	1HR
HCCHS	10	3.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	3.4E-09	1.3E+01	N/A	--	3686.4	3.2E+00	--	--	1HR
HCKGS	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.0E-09	1.3E+01	N/A	--	12000.0	1.5E+03	--	--	1HR
HCKHS	10	8.0E-09	1.3E+01	8.0E-09	1.3E+01	N/A	--	N/A	--	8.0E-09	1.3E+01	N/A	--	8.0E-09	1.3E+01	8.0E-09	1.3E+01	13600.0	1.7E+03	--	--	1HR
HCXVS	10	N/A	--	N/A	--	N/A	--	8.0E-09	1.3E+01	N/A	--	N/A	--	8.0E-09	1.3E+01	N/A	--	12000.0	1.6E+03	--	--	1HR
HCHVS	10	6.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	6.8E-09	1.3E+01	N/A	--	6.8E-09	1.3E+01	6.8E-09	1.3E+01	4536.0	1.0E+01	--	--	1HR
HCPGS	10	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01	3120.0	6.5E+00	--	--	1HR
HCPHS	10	1.6E-09	1.3E+01	N/A	--	1.6E-09	1.3E+01	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01	N/A	--	5616.0	1.2E+01	--	--	1HR
HCPVS	10	1.6E-09	1.3E+01	N/A	--	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01	2000.0	6.0E+00	--	--	1HR
HCBGS	10	1.6E-09	1.3E+01	N/A	--	1.6E-09	1.3E+01	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01	3400.0	1.5E+01	--	--	1HR
HCBVS	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-09	1.3E+01	1.6E-09	1.3E+01	3400.0	1.5E+01	--	--	1HR
HCRGS	10	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	7.2E-09	1.3E+01	2560.0	1.1E+01	--	--	1HR
HCRVS	10	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	N/A	--	7.2E-09	1.3E+01	7.2E-09	1.3E+01	2400.0	1.0E+01	--	--	1HR
HCSVS	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-09	1.3E+01	3.5E-09	1.3E+01	5424.0	1.4E+03	--	--	1HR
HCBHC	11	2.9E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-09	2.6E+01	5.8E-09	2.6E+01	N/A	--	288.0	--	6.0E+00	1.3E-03	1 HR
HCCGC	11	1.4E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-09	2.6E+01	N/A	--	38.4	--	1.6E+00	1.6E-01	1 HR
HCCHC	11	1.4E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-09	2.6E+01	2.9E-09	2.6E+01	N/A	--	76.8	--	3.2E+00	8.0E-04	1 HR

File: HDLNAT.WK1, Page 6 Date 18-Aug-87

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

Accident Frequencies and Range Factors | Agent Available and Released

SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCNVC	11	2.2E-09	2.6E+01	N/A	--	N/A	--	N/A	--	2.2E-09	2.6E+01	N/A	--	4.3E-09	2.6E+01	2.2E-09	2.6E+01	378.0	--	3.2E+01	4.2E-05	1 HR
HCPGC	11	4.8E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-10	2.6E+01	4.8E-10	2.6E+01	52.0	--	6.5E+00	1.1E-01	1 HR
HCPHC	11	4.8E-10	2.6E+01	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	4.8E-10	2.6E+01	9.6E-10	2.6E+01	N/A	--	93.6	--	1.2E+01	7.0E-04	1 HR
HCPVC	11	4.8E-10	2.6E+01	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	N/A	--	9.6E-10	2.6E+01	4.8E-10	2.6E+01	48.0	--	6.0E+00	1.0E-05	1 HR
HCDGC	11	3.6E-10	2.6E+01	N/A	--	3.6E-10	2.6E+01	N/A	--	N/A	--	N/A	--	7.2E-10	2.6E+01	3.6E-10	2.6E+01	87.0	--	1.5E+01	1.7E-01	1 HR
HCQVC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	2.6E+01	3.6E-10	2.6E+01	87.0	--	1.5E+01	6.0E-06	1 HR
HCRGC	11	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	1.8E-09	2.6E+01	9.0E-10	2.6E+01	160.5	--	2.1E+01	1.0E+00	1 HR
HCRVC	11	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	1.8E-09	2.6E+01	9.0E-10	2.6E+01	150.0	--	2.0E+01	5.0E-06	1 HR
HCDHC	12	2.1E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	2.6E+01	4.1E-10	2.6E+01	N/A	--	280.0	--	6.0E+00	1.3E-03	1 HR
HCCGC	12	1.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	2.6E+01	N/A	--	38.4	--	1.6E+00	1.6E-01	1 HR
HCCHC	12	1.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	2.6E+01	2.1E-10	2.6E+01	N/A	--	76.8	--	3.2E+00	8.0E-04	1 HR
HCNVC	12	1.5E-10	2.6E+01	N/A	--	N/A	--	N/A	--	1.5E-10	2.6E+01	N/A	--	3.1E-10	2.6E+01	1.5E-10	2.6E+01	378.0	--	3.2E+01	4.2E-05	1 HR
HCPGC	12	3.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.9E-11	2.6E+01	3.4E-11	2.6E+01	52.0	--	6.5E+00	1.1E-01	1 HR
HCPHC	12	3.4E-11	2.6E+01	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	3.4E-11	2.6E+01	6.9E-11	2.6E+01	N/A	--	93.6	--	1.2E+01	7.0E-04	1 HR
HCPVC	12	3.4E-11	2.6E+01	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.9E-11	2.6E+01	3.4E-11	2.6E+01	48.0	--	6.0E+00	1.0E-05	1 HR
HCDGC	12	2.6E-11	2.6E+01	N/A	--	2.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	5.2E-11	2.6E+01	2.6E-11	2.6E+01	87.0	--	1.5E+01	1.7E-01	1 HR
HCQVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-11	2.6E+01	2.6E-11	2.6E+01	87.0	--	1.5E+01	6.0E-06	1 HR
HCRGC	12	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	1.3E-10	2.6E+01	6.5E-11	2.6E+01	160.5	--	2.1E+01	1.0E+00	1 HR
HCRVC	12	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	1.3E-10	2.6E+01	6.5E-11	2.6E+01	150.0	--	2.0E+01	5.0E-06	1 HR
HCDGC	17	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E-13	2.6E+01	6.0E-13	2.6E+01	440.0	--	--	7.8E-01	1HR
HCRGC	17	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	6.0E-13	2.6E+01	160.5	--	--	1.4E-01	1HR
HCRVC	17	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	N/A	--	6.0E-13	2.6E+01	6.0E-13	2.6E+01	150.0	--	--	4.7E-06	1HR
HCDGC	18	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-12	2.6E+01	1.2E-12	2.6E+01	220.0	--	--	7.8E-01	1HR
HCRGC	18	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	1.2E-12	2.6E+01	10.7	--	--	1.4E-01	1HR
HCRVC	18	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	N/A	--	1.2E-12	2.6E+01	1.2E-12	2.6E+01	10.0	--	--	4.7E-06	1HR
HCDGC	19	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-15	3.1E+01	2.6E-15	3.1E+01	440.0	--	--	7.8E-01	1HR
HCRGC	19	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	2.6E-14	3.1E+01	160.5	--	--	1.4E-01	1HR
HCRVC	19	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	N/A	--	2.6E-14	3.1E+01	2.6E-14	3.1E+01	150.0	--	--	4.7E-06	1HR
HCDGC	21	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-18	3.1E+01	3.4E-18	3.1E+01	220.0	--	--	7.8E-01	1HR

File: HDLNAT.WK1, Page 7 Date 18-Aug-87

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCRGC	21	3.1E-10	3.1E+01	N/A	--	3.1E-10	3.1E+01	N/A	--	3.1E-10	3.1E+01	N/A	--	3.1E-10	3.1E+01	3.1E-10	3.1E+01	10.7	--	--	1.4E-01	1HR
HCRVC	21	3.1E-10	3.1E+01	N/A	--	3.1E-10	3.1E+01	N/A	--	3.1E-10	3.1E+01	N/A	--	3.1E-10	3.1E+01	3.1E-10	3.1E+01	10.0	--	--	4.7E-06	1HR
HCDNC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.7E-11	2.6E+01	N/A	--	200.0	3.0E+01	6.0E+00	--	1HR
HCCGC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--	30.4	8.0E+00	1.6E+00	--	1HR
HCCNC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--	76.8	1.6E+01	3.2E+00	--	1HR
HCNVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	378.0	3.5E+02	3.2E+01	--	1HR
HCPGC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--	52.0	3.2E+01	6.5E+00	--	1HR
HCPNC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--	93.6	5.8E+01	1.2E+01	--	1HR
HCPVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--	48.0	3.0E+01	6.0E+00	--	1HR
HCDGC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	87.0	7.3E+01	1.5E+01	--	1HR
HCDVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	87.0	7.3E+01	1.5E+01	--	1HR
HCRGC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-11	2.6E+01	N/A	--	160.5	1.4E+02	2.1E+01	--	1HR
HCRVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-11	2.6E+01	N/A	--	150.0	1.3E+02	2.0E+01	--	1HR
HCDNC	23	2.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.3E-11	2.6E+01	2.3E-11	2.6E+01	N/A	--	1152.0	3.0E+01	6.0E+00	--	1HR
HCCGC	23	3.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-11	2.6E+01	N/A	--	460.8	8.0E+00	1.6E+00	--	1HR
HCCNC	23	3.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-11	2.6E+01	3.5E-11	2.6E+01	N/A	--	921.6	1.6E+01	3.2E+00	--	1HR
HCNVC	23	1.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.3E-11	2.6E+01	N/A	--	1.3E-11	2.6E+01	1.3E-11	2.6E+01	1134.0	3.5E+02	3.2E+01	--	1HR
HCPGC	23	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01	700.0	3.2E+01	6.5E+00	--	1HR
HCPNC	23	1.4E-11	2.6E+01	N/A	--	1.4E-11	2.6E+01	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01	N/A	--	1404.0	5.8E+01	1.2E+01	--	1HR
HCPVC	23	1.4E-11	2.6E+01	N/A	--	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01	720.0	3.0E+01	6.0E+00	--	1HR
HCDGC	23	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01	870.0	7.3E+01	1.5E+01	--	1HR
HCDVC	23	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01	870.0	7.3E+01	1.5E+01	--	1HR
HCRGC	23	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01	642.0	1.4E+02	2.1E+01	--	1HR
HCRVC	23	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	N/A	--	7.2E-12	2.6E+01	7.2E-12	2.6E+01	600.0	1.3E+02	2.0E+01	--	1HR
HCDNC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.2E-11	2.6E+01	N/A	--	200.0	3.0E+01	6.0E+00	--	1HR
HCCGC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	2.6E+01	N/A	--	30.4	8.0E+00	1.6E+00	--	1HR
HCCNC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	2.6E+01	N/A	--	76.8	1.6E+01	3.2E+00	--	1HR
HCNVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.6E-11	2.6E+01	N/A	--	378.0	3.5E+02	3.2E+01	--	1HR
HCPGC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--	52.0	3.2E+01	6.5E+00	--	1HR

File: HDLNAT.WK1, Page 8 Date 18-Aug-87

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
		Accident Frequencies and Range Factors																Agent Available and Released				
HCPMC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--	93.6	5.8E+01	1.2E+01	--	1HR
HCPVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--	48.0	3.0E+01	6.0E+00	--	1HR
HCDGC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	87.0	7.3E+01	1.5E+01	--	1HR
HCDVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	87.0	7.3E+01	1.5E+01	--	1HR
HCRGC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-11	2.6E+01	N/A	--	160.5	1.4E+02	2.1E+01	--	1HR
HCRVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-11	2.6E+01	N/A	--	150.0	1.3E+02	2.0E+01	--	1HR
HCBMC	25	1.7E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	2.6E+01	1.7E-11	2.6E+01	N/A	--	1152.0	3.0E+01	6.0E+00	--	1HR
HCCGC	25	2.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.5E-11	2.6E+01	N/A	--	460.8	8.0E+00	1.6E+00	--	1HR
HCCMC	25	2.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.5E-11	2.6E+01	2.5E-11	2.6E+01	N/A	--	921.6	1.6E+01	3.2E+00	--	1HR
HCNVC	25	9.3E-12	2.6E+01	N/A	--	N/A	--	N/A	--	9.3E-12	2.6E+01	N/A	--	9.3E-12	2.6E+01	9.3E-12	2.6E+01	1134.0	3.5E+02	3.2E+01	--	1HR
HCPGC	25	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01	780.0	3.2E+01	6.5E+00	--	1HR
HCPMC	25	1.0E-11	2.6E+01	N/A	--	1.0E-11	2.6E+01	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01	N/A	--	1404.0	5.8E+01	1.2E+01	--	1HR
HCPVC	25	1.0E-11	2.6E+01	N/A	--	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01	720.0	3.0E+01	6.0E+00	--	1HR
HCDGC	25	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01	870.0	7.3E+01	1.5E+01	--	1HR
HCDVC	25	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01	870.0	7.3E+01	1.5E+01	--	1HR
HCRGC	25	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01	642.0	1.4E+02	2.1E+01	--	1HR
HCRVC	25	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	N/A	--	5.2E-12	2.6E+01	5.2E-12	2.6E+01	600.0	1.3E+02	2.0E+01	--	1HR
HCBGF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	440.0	--	--	--	--
HCBMC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	280.0	--	--	--	--
HCCGC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	38.4	--	--	--	--
HCCMC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	76.8	--	--	--	--
HCKGF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	1500.0	--	--	--	--
HCKMF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	1700.0	--	--	--	--
HCKVF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	1600.0	--	--	--	--
HCNVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	378.0	--	--	--	--
HCPGC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	52.0	--	--	--	--
HCPMC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HCPVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	48.0	--	--	--	--
HCDGC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--

File: HDLNAT.WK1, Page 9 Date 21-Aug-87

HANDLING ACCIDENTS - NATIONAL PROCESSING OPTION - PER PALLET OR CONTAINER

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	OP. NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HCBVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HCRGC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	160.5	--	--	--	--
HCRVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	150.0	--	--	--	--
HCSVF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	1356.0	--	--	--	--
HCBGF	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	2640.0	--	--	--	--
HCBNC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	1152.0	--	--	--	--
HCCGC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	460.8	--	--	--	--
HCCNC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	921.6	--	--	--	--
HCXGF	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	3000.0	--	--	--	--
HCKNF	27	0.0E+00	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	3400.0	--	--	--	--
HCKVF	27	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	3200.0	--	--	--	--
HCNVC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	1134.0	--	--	--	--
HCPGC	27	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	700.0	--	--	--	--
HCPNC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	1404.0	--	--	--	--
HCPVC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	720.0	--	--	--	--
HCQGC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	870.0	--	--	--	--
HCQVC	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	870.0	--	--	--	--
HCRGL	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	642.0	--	--	--	--
HCRVC	27	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	600.0	--	--	--	--
HCSVF	27	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	1356.0	--	--	--	--
HCRGC	29	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	9.0E-09	2.6E+01	160.5	--	2.1E+01	7.1E-02	1 HR
HCRVC	29	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	N/A	--	9.0E-09	2.6E+01	9.0E-09	2.6E+01	150.0	--	2.0E+01	1.0E-03	1 HR
HCRGC	30	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	1.8E-08	2.6E+01	10.7	--	1.1E+01	--	INST
HCRVC	30	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	N/A	--	1.8E-08	2.6E+01	1.8E-08	2.6E+01	10.0	--	1.0E+01	--	INST
HCRGC	31	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	1.3E-10	2.6E+01	642.0	1.4E+02	2.1E+01	--	1HR
HCRVC	31	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	N/A	--	1.3E-10	2.6E+01	1.3E-10	2.6E+01	600.0	1.3E+02	2.0E+01	--	1HR
HCBGS	32	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-03	1.0E+01	1.0E-03	1.0E+01	220.0	--	--	NEGL	--
HCRGS	32	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	1.0E-03	1.0E+01	10.7	--	--	NEGL	--
HCRVS	32	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	N/A	--	1.0E-03	1.0E+01	1.0E-03	1.0E+01	10.0	--	--	NEGL	--

File: HFNAT.WK1   Page 1   Date 20-Aug-87

NATIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)

Agent Available and Released

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HFBGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E-09	1.3E+01	N/A	--	440.0	220.0	--	--	1hr
HFBHS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.2E-09	1.3E+01	N/A	--	208.0	6.0	--	--	1hr
HFCGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-10	1.3E+01	N/A	--	48.0	1.6	--	--	1hr
HFCHS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-10	1.3E+01	N/A	--	96.0	3.2	--	--	1hr
HFKGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--	1500.0	1500.0	--	--	1hr
HFKHS	1	N/A	--	N/A	---	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--	1700.0	1700.0	--	--	1hr
HFKVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.6E-09	1.3E+01	N/A	--	1600.0	1600.0	--	--	1hr
HFMVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.8E-09	1.3E+01	N/A	--	378.0	10.5	--	--	1hr
HFPGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	52.0	6.5	--	--	1hr
HFPHS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	93.6	11.7	--	--	1hr
HFPVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	48.0	6.0	--	--	1hr
HFQGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	87.0	14.5	--	--	1hr
HFQVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-10	1.3E+01	N/A	--	87.0	14.5	--	--	1hr
HFRGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	1.3E+01	N/A	--	160.5	10.7	--	--	1hr
HFRVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	1.3E+01	N/A	--	150.0	10.0	--	--	1hr
HFSVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-06	1.3E+01	N/A	--	1356.0	1356.0	--	--	1hr
HFBGC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-16	3.1E+01	N/A	--	220.0	--	--	NEGL	--
HFBHC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	6.0	--	--	--	--
HFCGC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	1.6	--	--	--	--
HFCHC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	3.2	--	--	--	--
HFKGC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.4E-16	3.1E+01	N/A	--	1500.0	--	--	NEGL	--
HFKHC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.4E-16	3.1E+01	N/A	--	1700.0	--	--	NEGL	--
HFKVC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.4E-16	3.1E+01	N/A	--	1600.0	--	--	NEGL	--
HFMVC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-17	3.1E+01	N/A	--	10.5	--	--	NEGL	--
HFPGC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	6.5	--	--	--	--
HFPHC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	11.7	--	--	--	--
HFPVC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	6.0	--	--	--	--
HFQGS	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	14.5	--	--	--	--
HFQVS	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	14.5	--	--	--	--

File: HFNAT.WK1   Page 2   Date 20-Aug-87

NATIONAL COLLOCATION OPTION - FACILITY HANDLING

		Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)																Agent Available and Released				
	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HFRGC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-16	3.1E+01	N/A	--	10.7	--	--	NEGL	--
HFRVC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-16	3.1E+01	N/A	--	10.0	--	--	NEGL	--
HFSVC	2	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.5E-15	3.1E+01	N/A	--	1356.0	--	--	NEGL	--
HFDGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	3.1E+01	N/A	--	440.0	--	--	2.20E+01	10min
HFDHF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.4E-11	3.1E+01	N/A	--	288.0	--	--	3.00E-01	10min
HFCGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	--	--
HFCHF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	96.0	--	--	--	--
HFKGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	3.1E+01	N/A	--	1500.0	--	--	1.50E+02	10min
HFKHF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	3.1E+01	N/A	--	1700.0	--	--	8.57E+01	10min
HFKVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	3.1E+01	N/A	--	1600.0	--	--	4.00E+01	10min
HFMVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-10	3.1E+01	N/A	--	378.0	--	--	2.63E-01	10min
HFPGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	52.0	--	--	--	--
HFPHF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	93.6	--	--	--	--
HFPVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	--	--
HFQGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	--	--
HFQVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	--	--
HFRGF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.1E-11	3.1E+01	N/A	--	160.5	--	--	1.07E+00	10min
HFRVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.1E-11	3.1E+01	N/A	--	150.0	--	--	2.50E-01	10min
HFSVF	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-09	3.1E+01	N/A	--	1356.0	--	--	3.39E+01	10min
HFSVS	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-07	1.3E+01	N/A	--	1356.0	--	--	9.00E-05	1hr
HFBGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	288.0	--	--	--	--
HFDHC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	288.0	--	--	--	--
HFCGC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	--	--
HFCHC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	96.0	--	--	--	--
HFKGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	1500.0	--	--	--	--
HFKHF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	1700.0	--	--	--	--
HFKVF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	1600.0	--	--	--	--
HFMVC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	378.0	--	--	--	--
HFFGC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	52.0	--	--	--	--

File: HFNAT.WK1   Page 3   Date 20-Aug-87

NATIONAL COLLOCATION OPTION - FACILITY HANDLING

		Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container)																Agent Available and Released				
	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HFPHC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	93.6	--	--	--	--
HFPVC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	--	--
HFQGC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	--	--
HFQVC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	--	--
HFRGC	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	160.5	--	--	--	--
HFRVC	5	N/A	--	N/A	---	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	150.0	--	--	--	--
HFSVF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	1356.0	--	--	--	--
HFBGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.3E-10	1.3E+01	N/A	--	440.0	220.0	--	--	1hr
HFBHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.5E-09	1.3E+01	N/A	--	288.0	6.0	--	--	1hr
HFCGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	--	--
HFCHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	96.0	--	--	--	--
HFKGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-09	1.3E+01	N/A	--	1500.0	1500.0	--	--	1hr
HFKHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-09	1.3E+01	N/A	--	1700.0	1700.0	--	--	1hr
HFKVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-09	1.3E+01	N/A	--	1600.0	1600.0	--	--	1hr
HFMVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-09	1.3E+01	N/A	--	378.0	10.5	--	--	1hr
HFPGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	52.0	--	--	--	--
HFPHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	93.6	--	--	--	--
HFPVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	--	--
HFQGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	--	--
HFQVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	--	--
HFRGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	1.3E+01	N/A	--	160.5	10.7	--	--	1hr
HFRVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	1.3E+01	N/A	--	150.0	10.0	--	--	1hr
HFSVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	1.3E+01	N/A	--	1356.0	1356.0	--	--	1hr
HFBGC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.3E-18	3.1E+01	N/A	--	220.0	--	--	NEGL	--
HFBHC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.3E-18	3.1E+01	N/A	--	6.0	--	--	NEGL	--
HFCGC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E-19	3.1E+01	N/A	--	1.6	--	--	NEGL	--
HFCHC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E-19	3.1E+01	N/A	--	3.2	--	--	NEGL	--
HFKGC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-17	3.1E+01	N/A	--	1500.0	--	--	NEGL	--
HFKHC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-17	3.1E+01	N/A	--	1700.0	--	--	NEGL	--

File: HFNAT.WK1 Page 4 Date 20-Aug-87

NATIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container) — Agent Available and Released

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HFKVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-17	3.1E+01	N/A	--	1600.0	--	--	NEGL	--
HFMVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-18	3.1E+01	N/A	--	10.5	--	--	NEGL	--
HFF6C	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--	6.5	--	--	NEGL	--
HFPMC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--	11.7	--	--	NEGL	--
HFPVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--	6.0	--	--	NEGL	--
HFQ6C	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--	14.5	--	--	NEGL	--
HFQVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-19	3.1E+01	N/A	--	14.5	--	--	NEGL	--
HFR6C	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-18	3.1E+01	N/A	--	10.7	--	--	NEGL	--
HFFVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-18	3.1E+01	N/A	--	10.0	--	--	NEGL	--
HFSVC	8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-15	3.1E+01	N/A	--	1356.0	--	--	NEGL	--
HFSVC	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-16	3.1E+01	N/A	--	1356.0	--	--	1.35E-04	1hr
HFB6C	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-19	3.1E+01	N/A	--	440.0	--	--	NEGL	--
HFDMC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-18	3.1E+01	N/A	--	288.0	--	--	NEGL	--
HFC6C	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	NEGL	--
HFCMC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	96.0	--	--	NEGL	--
HFK6C	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-18	3.1E+01	N/A	--	1500.0	--	--	NEGL	--
HFKMC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-18	3.1E+01	N/A	--	1700.0	--	--	NEGL	--
HFKVC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-18	3.1E+01	N/A	--	1600.0	--	--	NEGL	--
HFMVC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-18	3.1E+01	N/A	--	378.0	--	--	NEGL	--
HFP6C	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	52.0	--	--	NEGL	--
HFPMC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	93.6	--	--	NEGL	--
HFPVC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	48.0	--	--	NEGL	--
HFQ6C	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	--	--	NEGL	--
HFQVC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00		N/A	--	87.0	-	--	NEGL	--
HFR6C	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-18	3.1E+01	N/A	--	160.5	--	--	NEGL	--
HFRVC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-18	3.1E+01	N/A	--	150.0	--	--	NEGL	--
HFSVC	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-17	3.1E+01	N/A	--	1356.0	--	--	NEGL	--
HFDMC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.8E-11	2.6E+01	N/A	--	288.0	30.0	6.0	--	1hr
HFC6C	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-11	2.6E+01	N/A	--	48.0	8.0	1.6	--	1hr

File: HFNAT.WK1 Page 5 Date 20-Aug-87

NATIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container) — Agent Available and Released

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HFCHC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-11	2.6E+01	N/A	--	96.0	16.0	3.2	--	1hr
HFMVC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--	378.0	157.5	31.5	--	1hr
HFPGC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-12	2.6E+01	N/A	--	52.0	32.5	6.5	--	1hr
HFPHC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-12	2.6E+01	N/A	--	93.6	58.5	11.7	--	1hr
HFPVC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.6E-12	2.6E+01	N/A	--	48.0	30.0	6.0	--	1hr
HFQGC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	N/A	--	87.0	72.5	14.5	--	1hr
HFQVC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-12	2.6E+01	N/A	--	87.0	72.5	14.5	--	1hr
HFRGC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-11	2.6E+01	N/A	--	160.5	139.1	21.4	--	1hr
HFRVC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.8E-11	2.6E+01	N/A	--	150.0	130.0	20.0	--	1hr
HFDHC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	6.0	--	6.0	--	INSTANT
HFCGC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	1.6	--	1.6	--	INSTANT
HFCHC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	3.2	--	3.2	--	INSTANT
HFMVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	10.5	--	10.5	--	INSTANT
HFPGC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	6.5	--	6.5	--	INSTANT
HFPHC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	11.7	--	11.7	--	INSTANT
HFPVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	6.0	--	6.0	--	INSTANT
HFQGC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	14.5	--	14.5	--	INSTANT
HFQVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	14.5	--	14.5	--	INSTANT
HFRGC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	10.7	--	10.7	--	INSTANT
HFRVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-10	2.6E+01	N/A	--	10.0	--	10.0	--	INSTANT
HFDHC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.2E-11	2.6E+01	N/A	--	288.0	--	6.0	1.70E-03	1hr
HFCGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-11	2.6E+01	N/A	--	48.0	--	1.6	3.70E-01	1hr
HFCHC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-11	2.6E+01	N/A	--	96.0	--	3.2	1.60E-03	1hr
HFMVC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	378.0	--	31.5	3.30E-05	1hr
HFPGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-11	2.6E+01	N/A	--	52.0	--	6.5	3.90E-01	1hr
HFPHC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-11	2.6E+01	N/A	--	93.6	--	11.7	1.90E-03	1hr
HFPVC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-11	2.6E+01	N/A	--	48.0	--	6.0	1.10E-05	1hr
HFQGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-12	2.6E+01	N/A	--	87.0	--	14.5	4.50E-01	1hr
HFQVC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.0E-12	2.6E+01	N/A	--	87.0	--	14.5	1.40E-05	1hr

NATIONAL COLLOCATION OPTION - FACILITY HANDLING

Accident Frequencies for Facility Handling Operations (HF) (Events per Pallet or Container) — Agent Available and Released

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HFRGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--	160.5	--	21.4	9.00E-01	1hr
HFRVC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--	150.0	--	20.0	2.90E-05	1hr
HFDMC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-14	2.6E+01	N/A	--	200.0	30.0	6.0	--	1hr
HFCGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.6E-15	2.6E+01	N/A	--	48.0	8.0	1.6	--	1hr
HFCMC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.6E-15	2.6E+01	N/A	--	96.0	16.0	3.2	--	1hr
HFNVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.9E-15	2.6E+01	N/A	--	378.0	157.5	31.5	--	1hr
HFPGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-15	2.6E+01	N/A	--	52.0	32.5	6.5	--	1hr
HFFMC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-15	2.6E+01	N/A	--	93.6	58.5	11.7	--	1hr
HFFVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-15	2.6E+01	N/A	--	48.0	30.0	6.0	--	1hr
HFQGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-15	2.6E+01	N/A	--	87.0	72.5	14.5	--	1hr
HFQVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-15	2.6E+01	N/A	--	87.0	72.5	14.5	--	1hr
HFRGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-15	2.6E+01	N/A	--	160.5	139.1	21.4	--	1hr
HFRVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-15	2.6E+01	N/A	--	150.0	130.0	20.0	--	1hr

ONSITE DISPOSAL OPTION (PER PALLET OR CONTAINER)

Accident Frequencies for Onsite Handling Operations (HD) — Agent Available and Released

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HODGC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.1E-08	1.3E+01	6.1E-08	1.3E+01	440.0	--	--	4.3E+00	1HR
HODHC	1	1.6E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	1.3E+01	1.6E-08	1.3E+01	N/A	--	288.0	--	--	1.3E-03	1HR
HOCGC	1	2.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-09	1.3E+01	N/A	--	38.4	--	--	1.1E-01	1HR
HOCHC	1	2.8E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-09	1.3E+01	N/A	--	N/A	--	76.8	--	--	1.3E-03	1HR
HOKGC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-08	1.3E+01	N/A	--	1500.0	--	--	6.4E+00	1HR
HOKHC	1	2.0E-08	1.3E+01	2.0E-08	1.3E+01	N/A	--	N/A	--	2.0E-08	1.3E+01	N/A	--	2.0E-08	1.3E+01	2.0E-08	1.3E+01	1700.0	--	--	2.5E-02	1HR
HOKVC	1	N/A	--	N/A	--	N/A	--	2.0E-08	1.3E+01	N/A	--	N/A	--	2.0E-08	1.3E+01	N/A	--	1600.0	--	--	2.7E-04	1HR
HOMVC	1	1.2E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.2E-08	1.3E+01	N/A	--	1.2E-08	1.3E+01	1.2E-08	1.3E+01	378.0	--	--	1.7E-05	1HR
HOPGC	1	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	1.3E+01	52.0	--	--	--	--
HOPHC	1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HOPVC	1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	48.0	--	--	--	--
HOQGC	1	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HOQVC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HORGC	1	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	4.8E-08	1.3E+01	160.5	--	--	4.5E-01	1HR
HORVC	1	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	N/A	--	4.8E-08	1.3E+01	4.8E-08	1.3E+01	150.0	--	--	1.6E-05	1HR
HOSVC	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-07	1.3E+01	5.2E-07	1.3E+01	1356.0	--	--	2.7E-04	1HR
HOKHF	2	N/A	--	5.2E-10	3.1E+01	N/A	--	N/A	--	5.2E-10	3.1E+01	N/A	--	5.2E-10	3.1E+01	N/A	--	1700.0	--	--	8.5E+01	10 MIN
HODGC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-07	1.3E+01	1.3E-07	1.3E+01	440.0	--	--	4.3E+00	1HR
HODHC	3	3.7E-07	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.7E-07	1.3E+01	3.7E-07	1.3E+01	N/A	--	288.0	--	--	1.3E-03	1HR
HOCGC	3	8.9E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	8.9E-08	1.3E+01	N/A	--	38.4	--	--	1.1E-01	1HR
HOCHC	3	8.9E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.9E-08	1.3E+01	N/A	--	N/A	--	76.8	--	--	1.3E-03	1HR
HOMVC	3	7.1E-07	1.3E+01	N/A	--	N/A	--	N/A	--	7.1E-07	1.3E+01	N/A	--	7.1E-07	1.3E+01	7.1E-07	1.3E+01	378.0	--	--	1.7E-05	1HR
HOPGC	3	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.0E-08	1.3E+01	5.0E-08	1.3E+01	52.0	--	--	2.4E-01	1HR
HOPHC	3	5.0E-08	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	5.0E-08	1.3E+01	5.0E-08	1.3E+01	N/A	--	93.6	--	--	2.1E-03	1HR
HOPVC	3	5.0E-08	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	5.0E-08	1.3E+01	5.0E-08	1.3E+01	48.0	--	--	2.1E-05	1HR
HOGGC	3	5.0E-08	1.3E+01	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	5.0E-08	1.3E+01	5.0E-08	1.3E+01	87.0	--	--	5.6E-01	1HR
HOQVC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.0E-08	1.3E+01	5.0E-08	1.3E+01	87.0	--	--	2.1E-05	1HR
HORGC	3	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	2.6E-06	1.3E+01	160.5	--	--	4.5E-01	1HR
HORVC	3	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	N/A	--	2.6E-06	1.3E+01	2.6E-06	1.3E+01	150.0	--	--	1.6E-05	1HR

ONSITE DISPOSAL OPTION (PER PALLET OR CONTAINER)

		Accident Frequencies for Onsite Handling Operations (HD)																Agent Available and Released				
	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUBA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HDSVC	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.6E-07	1.3E+01	4.6E-07	1.3E+01	1356.0	--	--	2.7E-04	1HR
HDBGC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-09	1.3E+01	1.7E-09	1.3E+01	440.0	--	--	4.3E+00	1HR
HDDHC	4	8.0E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.0E-10	1.3E+01	8.0E-10	1.3E+01	N/A	--	288.0	--	--	1.3E-03	1HR
HDCGC	4	2.0E-11	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-11	1.3E+01	N/A	--	38.4	--	--	1.1E-01	1HR
HDCHC	4	2.0E-11	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-11	1.3E+01	N/A	--	N/A	--	76.8	--	--	1.3E-03	1HR
HDKGC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.7E-09	1.3E+01	N/A	--	1500.0	--	--	6.4E+00	1HR
HDKHC	4	7.2E-09	1.3E+01	6.7E-09	1.3E+01	N/A	--	N/A	--	6.7E-09	1.3E+01	N/A	--	6.7E-09	1.3E+01	7.2E-09	1.3E+01	1700.0	--	--	2.5E-02	1HR
HDKVC	4	N/A	--	N/A	--	N/A	--	7.2E-09	1.3E+01	N/A	--	N/A	--	6.7E-09	1.3E+01	N/A	--	1600.0	--	--	2.7E-04	1HR
HDMVC	4	6.9E-10	1.3E+01	N/A	--	N/A	--	N/A	--	6.9E-10	1.3E+01	N/A	--	6.9E-10	1.3E+01	6.9E-10	1.3E+01	378.0	--	--	1.7E-05	1HR
HDPGC	4	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	52.0	--	--	--	--
HDPHC	4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HDPVC	4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	48.0	--	--	--	--
HDQGC	4	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HDQVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HDRGC	4	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	3.1E-09	1.3E+01	160.5	--	--	4.5E-01	1HR
HDRVC	4	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	N/A	--	3.1E-09	1.3E+01	3.1E-09	1.3E+01	150.0	--	--	1.6E-05	1HR
HDSVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-08	1.3E+01	2.7E-08	1.3E+01	1356.0	--	--	2.7E-04	1HR
HDBGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	1.3E+01	6.3E-09	1.3E+01	440.0	2.2E+02	--	--	1HR
HDDHS	5	4.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-09	1.3E+01	4.4E-09	1.3E+01	N/A	--	288.0	6.0E+00	--	--	1HR
HDCGS	5	5.6E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.6E-10	1.3E+01	N/A	--	38.4	1.6E+00	--	--	1HR
HDCHS	5	5.6E-10	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	5.6E-10	1.3E+01	N/A	--	N/A	--	76.8	3.2E+00	--	--	1HR
HDKGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.0E-08	1.3E+01	N/A	--	1500.0	1.5E+03	--	--	1HR
HDKHS	5	5.0E-08	1.3E+01	5.0E-08	1.3E+01	N/A	--	N/A	--	5.0E-08	1.3E+01	N/A	--	5.0E-08	1.3E+01	5.0E-08	1.3E+01	1700.0	1.7E+03	--	--	1HR
HDKVS	5	N/A	--	N/A	--	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	5.0E-08	1.3E+01	N/A	--	1600.0	1.6E+03	--	--	1HR
HDMVS	5	3.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	3.4E-09	1.3E+01	N/A	--	3.4E-09	1.3E+01	3.4E-09	1.3E+01	378.0	1.0E+01	--	--	1HR
HDPGS	5	1.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	1.1E-09	1.3E+01	52.0	6.5E+00	--	--	1HR
HDPHS	5	1.1E-09	1.3E+01	N/A	--	1.1E-09	1.3E+01	N/A	--	N/A	--	1.1E-09	--	1.1E-09	1.3E+01	N/A	--	93.6	1.2E+01	--	--	1HR
HDPVS	5	1.1E-09	1.3E+01	N/A	--	1.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	1.1E-09	--	48.0	6.0E+00	--	--	1HR
HDQGS	5	1.1E-09	1.3E+01	N/A	--	1.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	1.1E-09	--	87.0	1.5E+01	--	--	1HR

ONSITE DISPOSAL OPTION (PER PALLET OR CONTAINER)

		Accident Frequencies for Onsite Handling Operations (HO)																Agent Available and Released				
	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HOBVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	1.3E+01	1.1E-09	--	87.0	1.5E+01	--	--	1HR
HORGS	5	1.4E-08	1.3E+01	N/A	--	1.4E-08	1.3E+01	N/A	--	1.4E-08	1.3E+01	N/A	--	1.4E-08	1.3E+01	1.4E-08	1.3E+01	160.5	1.1E+01	--	--	1HR
HORVS	5	1.4E-08	1.3E+01	N/A	--	1.4E-08	1.3E+01	N/A	--	1.4E-08	1.3E+01	N/A	--	1.4E-08	1.3E+01	1.4E-08	1.3E+01	150.0	1.0E+01	--	--	1HR
HOSVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-06	1.3E+01	1.4E-06	1.3E+01	1356.0	1.4E+03	--	--	1HR
HOBGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.2E-11	3.1E+01	6.2E-11	3.1E+01	440.0	--	--	2.2E+01	10 MIN
HOBHF	6	1.9E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	3.1E+01	1.9E-10	3.1E+01	N/A	--	288.0	--	--	3.0E-01	10 MIN
HOCGF	6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	38.4	--	--	--	--
HOCHF	6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	76.8	--	--	--	--
HOKGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--	1500.0	--	--	1.5E+02	10 MIN
HOKHF	6	2.1E-10	3.1E+01	2.1E-10	3.1E+01	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--	2.1E-10	3.1E+01	2.1E-10	3.1E+01	1700.0	--	--	8.5E+01	10 MIN
HOKVF	6	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--	1600.0	--	--	4.0E+01	10 MIN
HOMVF	6	2.7E-10	3.1E+01	N/A	--	N/A	--	N/A	--	2.7E-10	3.1E+01	N/A	--	2.7E-10	3.1E+01	2.7E-10	3.1E+01	378.0	--	--	2.6E-01	10 MIN
HOPGF	6	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	52.0	--	--	--	--
HOPHF	6	0.0E+00	-	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HOPVF	6	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	48.0	--	--	--	--
HOQGF	6	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HOQVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HORGF	6	1.6E-10	3.1E+01	N/A	--	1.6E-10	3.1E+01	N/A	--	1.6E-10	3.1E+01	N/A	--	1.6E-10	3.1E+01	1.6E-10	3.1E+01	160.5	--	--	1.1E+00	10 MIN
HORVF	6	1.6E-10	3.1E+01	N/A	--	1.6E-10	3.1E+01	N/A	--	1.6E-10	3.1E+01	N/A	--	1.6E-10	3.1E+01	1.6E-10	3.1E+01	150.0	--	--	2.5E-01	10 MIN
HOSVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-09	3.1E+01	3.9E-09	3.1E+01	1356.0	--	--	3.4E+01	10 MIN
HOBGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.2E-09	1.3E+01	1.2E-09	1.3E+01	440.0	2.2E+02	--	--	1HR
HOBHS	7	3.7E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.7E-09	1.3E+01	3.7E-09	1.3E+01	N/A	--	288.0	6.0E+00	--	--	1HR
HOCGS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	38.4	--	--	--	--
HOCHS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	76.8	--	--	--	--
HOKGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-09	1.3E+01	N/A	--	1500.0	1.5E+03	--	--	1HR
HOKHS	7	4.1E-09	1.3E+01	4.1E-09	1.3E+01	N/A	--	N/A	--	4.1E-09	1.3E+01	N/A	--	4.1E-09	1.3E+01	4.1E-09	1.3E+01	1700.0	1.7E+03	--	--	1HR
HOKVS	7	N/A	--	N/A	--	N/A	--	4.1E-09	1.3E+01	N/A	--	N/A	--	4.1E-09	1.3E+01	N/A	--	1600.0	1.6E+03	--	--	1HR
HOMVS	7	5.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	5.4E-09	1.3E+01	N/A	--	5.4E-09	1.3E+01	5.4E-09	1.3E+01	378.0	1.0E+01	--	--	1HR
HOPGS	7	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	52.0	--	--	--	--

PAGE 4 DATE 21-Aug-87

ONSITE DISPOSAL OPTION (PER PALLET OR CONTAINER)

Accident Frequencies for Onsite Handling Operations (HD) — Agent Available and Released

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HDPMS	7	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HDPVS	7	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	48.0	--	--	--	--
HDQGS	7	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HDQVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HDRGS	7	3.2E-09	1.3E+01	N/A	--	3.2E-09	1.3E+01	N/A	--	3.2E-09	1.3E+01	N/A	--	3.2E-09	1.3E+01	3.2E-09	1.3E+01	160.5	1.1E+01	--	--	1HR
HDRVS	7	3.2E-09	1.3E+01	N/A	--	3.2E-09	1.3E+01	N/A	--	3.2E-09	1.3E+01	N/A	--	3.2E-09	1.3E+01	3.2E-09	1.3E+01	150.0	1.0E+01	--	--	1HR
HDSVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-08	1.3E+01	7.7E-08	1.3E+01	1356.0	1.4E+03	--	--	1HR
HDDMC	11	2.9E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.9E-09	2.6E+01	2.9E-09	2.6E+01	N/A	--	288.0	--	6.0E+00	1.3E-03	1HR
HDCGC	11	1.4E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-09	2.6E+01	N/A	--	38.4	--	1.6E+00	1.6E-01	1HR
HDCMC	11	1.4E-09	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-09	2.6E+01	N/A	--	N/A	--	76.8	--	3.2E+00	8.0E-04	1HR
HDMVC	11	2.2E-09	2.6E+01	N/A	--	N/A	--	N/A	--	2.2E-09	2.6E+01	N/A	--	2.2E-09	2.6E+01	2.2E-09	2.6E+01	378.0	--	3.2E+01	4.2E-05	1HR
HDPGC	11	4.8E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-10	2.6E+01	4.8E-10	2.6E+01	52.0	--	6.5E+00	1.1E-01	1HR
HDPMC	11	4.8E-10	2.6E+01	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	4.8E-10	2.6F+01	4.8E-10	2.6E+01	N/A	--	93.6	--	1.2E+01	7.0E-04	1HR
HDPVC	11	4.8E-10	2.6E+01	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	N/A	--	4.8E-10	2.6E+01	4.8E-10	2.6E+01	48.0	--	6.0E+00	1.0E-05	1HR
HDQGC	11	3.6E-10	2.6E+01	N/A	--	3.6E-10	2.6E+01	N/A	--	N/A	--	N/A	--	3.6E-10	2.6E+01	3.6E-10	2.6E+01	87.0	--	1.5E+01	1.7E-01	1HR
HDQVC	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.6E-10	2.6E+01	3.6E-10	2.6E+01	87.0	--	1.5E+01	6.0E-06	1HR
HDRGC	11	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	9.0E-10	2.6E+01	160.5	--	2.1E+01	1.0E+00	1HR
HDRVC	11	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	N/A	--	9.0E-10	2.6E+01	9.0E-10	2.6E+01	150.0	--	2.0E+01	5.0E-06	1HR
HDDMC	12	2.1E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	2.6E+01	2.1E-10	2.6E+01	N/A	--	288.0	--	6.0E+00	1.3E-03	1HR
HDCGC	12	1.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	2.6E+01	N/A	--	38.4	--	1.6E+00	1.6E-01	1HR
HDCMC	12	1.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-10	2.6E+01	N/A	--	N/A	--	76.8	--	3.2E+00	8.0E-04	1HR
HDMVC	12	1.5E-10	2.6E+01	N/A	--	N/A	--	N/A	--	1.5E-10	2.6E+01	N/A	--	1.5E-10	2.6E+01	1.5E-10	2.6E+01	378.0	--	3.2E+01	4.2E-05	1HR
HDPGC	12	3.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-11	2.6E+01	3.4E-11	2.6E+01	52.0	--	6.5E+00	1.1E-01	1HR
HDPMC	12	3.4E-11	2.6E+01	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	3.4E-11	2.6E+01	3.4E-11	2.6E+01	N/A	--	93.6	--	1.2E+01	7.0E-04	1HR
HDPVC	12	3.4E-11	2.6E+01	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	3.4E-11	2.6E+01	3.4E-11	2.6E+01	48.0	--	6.0E+00	1.0E-05	1HR
HDQGC	12	2.6E-11	2.6E+01	N/A	--	2.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	2.6E-11	2.6E+01	2.6E-11	2.6E+01	87.0	--	1.5E+01	1.7E-01	1HR
HDQVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-11	2.6E+01	2.6E-11	2.6E+01	87.0	--	1.5E+01	6.0E-06	1HR
HDRGC	12	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	6.5E-11	2.6E+01	160.5	--	2.1E+01	1.0E+00	1HR
HDRVC	12	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	6.5E-11	2.6E+01	150.0	--	2.0E+01	5.0E-06	1HR

ONSITE DISPOSAL OPTION (PER PALLET OR CONTAINER)

		Accident Frequencies for Onsite Handling Operations (HO)																Agent Available and Released				
	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUBA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HODHC	22	8.7E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	8.7E-11	2.6E+01	8.7E-11	2.6E+01	N/A	--	288.0	3.0E+01	6.0E+00	--	1HR
HOCGC	22	4.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--	38.4	8.0E+00	1.6E+00	--	1HR
HOCHC	22	4.3E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	4.3E-11	2.6E+01	N/A	--	N/A	--	76.8	1.6E+01	3.2E+00	--	1HR
HOMVC	22	6.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	6.5E-11	2.6E+01	6.5E-11	2.6E+01	378.0	3.5E+02	3.2E+01	--	1HR
HOPGC	22	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01	52.0	3.2E+01	6.5E+00	--	1HR
HOPHC	22	1.4E-11	2.6E+01	N/A	--	1.4E-11	2.6E+01	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01	N/A	--	93.6	5.8E+01	1.2E+01	--	1HR
HOPVC	22	1.4E-11	2.6E+01	N/A	--	1.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	1.4E-11	2.6E+01	48.0	3.0E+01	6.0E+00	--	1HR
HOQGC	22	1.1E-11	2.6E+01	N/A	--	1.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	1.1E-11	2.6E+01	87.0	7.3E+01	1.5E+01	--	1HR
HOQVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	1.1E-11	2.6E+01	87.0	7.3E+01	1.5E+01	--	1HR
HORGC	22	2.7E-11	2.6E+01	N/A	--	2.7E-11	2.6E+01	N/A	--	2.7E-11	2.6E+01	N/A	--	2.7E-11	2.6E+01	2.7E-11	2.6E+01	160.5	1.4E+02	2.1E+01	--	1HR
HORVC	22	2.7E-11	2.6E+01	N/A	--	2.7E-11	2.6E+01	N/A	--	2.7E-11	2.6E+01	N/A	--	2.7E-11	2.6E+01	2.7E-11	2.6E+01	150.0	1.3E+02	2.0E+01	--	1HR
HODHC	24	6.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	6.2E-11	2.6E+01	6.2E-11	2.6E+01	N/A	--	288.0	3.0E+01	6.0E+00	--	1HR
HOCGC	24	3.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	2.6E+01	N/A	--	38.4	8.0E+00	1.6E+00	--	1HR
HOCHC	24	3.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-11	2.6E+01	N/A	--	N/A	--	76.8	1.6E+01	3.2E+00	--	1HR
HOMVC	24	4.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	4.6E-11	2.6E+01	N/A	--	4.6E-11	2.6E+01	4.6E-11	2.6E+01	378.0	3.5E+02	3.2E+01	--	1HR
HOPGC	24	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01	52.0	3.2E+01	6.5E+00	--	1HR
HOPHC	24	1.0E-11	2.6E+01	N/A	--	1.0E-11	2.6E+01	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01	N/A	--	93.6	5.8E+01	1.2E+01	--	1HR
HOPVC	24	1.0E-11	2.6E+01	N/A	--	1.0E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	1.0E-11	2.6E+01	48.0	3.0E+01	6.0E+00	--	1HR
HOQGC	24	7.7E-12	2.6E+01	N/A	--	7.7E-12	2.6E+01	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	7.7E-12	2.6E+01	87.0	7.3E+01	1.5E+01	--	1HR
HOQVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	7.7E-12	2.6E+01	87.0	7.3E+01	1.5E+01	--	1HR
HORGC	24	1.9E-11	2.6E+01	N/A	--	1.9E-11	2.6E+01	N/A	--	1.9E-11	2.6E+01	N/A	--	1.9E-11	2.6E+01	1.9E-11	2.6E+01	160.5	1.4E+02	2.1E+01	--	1HR
HORVC	24	1.9E-11	2.6E+01	N/A	--	1.9E-11	2.6E+01	N/A	--	1.9E-11	2.6E+01	N/A	--	1.9E-11	2.6E+01	1.9E-11	2.6E+01	150.0	1.3E+02	2.0E+01	--	1HR
HOBGF	26	N/A	--	N/A	--	N/A	--	N/A	-	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	440.0	--	--	--	--
HODHC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	288.0	--	--	--	--
HOCGC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	38.4	--	--	--	--
HOCHC	26	0.0E+00	--	N/A	-	N/A	-	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	76.8	--	--	--	--
HOKGF	26	N/A	-	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	1500.0	--	--	--	--
HOKHF	26	0.0E+00	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	1700.0	--	--	--	--
HOKVF	26	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	1600.0	--	--	--	--

ONSITE DISPOSAL OPTION (PER PALLET OR CONTAINER)

Accident Frequencies for Onsite Handling Operations (HD) — Agent Available and Released

	SCENARIO NUMBER	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HDMVC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	378.0	--	--	--	--
HDPGC	26	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	52.0	--	--	--	--
HDPHC	26	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HDPVC	26	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	48.0	--	--	--	--
HDDGC	26	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HDQVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	87.0	--	--	--	--
HDRGC	26	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	160.5	--	--	--	--
HDRVC	26	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	150.0	--	--	--	--
HDSVF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	1356.0	--	--	--	--

BARGE TRANSPORTATION OPTION FOR TON CONTAINER FROM APG TO JOHNSTON ATOLL
Handling accidents per ton container

(B) SCEN-ARIO	(C) OP.	(D) NO.	Accident Frequencies - Sending Site (APG) (E) ANAD FREQ	(F) RANGE FACTOR	(G) APG FREQ	(H) RANGE FACTOR	(I) LBAD FREQ	(J) RANGE FACTOR	(K) NAAP FREQ	(L) RANGE FACTOR	(M) PBA FREQ	(N) RANGE FACTOR	(O) PUDA FREQ	(P) RANGE FACTOR	(Q) TEAD FREQ	(R) RANGE FACTOR	(S) UMDA FREQ	(T) RANGE FACTOR	Agent Available and Released (U) AGENT AVAILABLE	(V) LBS SPILLED	(W) LBS DETONATED	(X) LBS EMITTED	(Y) DURATION TIME
HWKHS		1	N/A	--	2.0E-08	12.8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1700	1700	--	--	1 hr
HWKHS		2	N/A	--	5.2E-10	31.1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1700	--	--	8.5E+01	10 min
HWKHS		4	N/A	--	6.7E-09	12.8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1700	1700	--	--	1 hr
HWKHS		5	N/A	--	5.9E-09	12.8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1700	1700	--	--	1 hr
HWKHS		6	N/A	--	3.1E-10	31.1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1700	--	--	8.5E+01	1 hr
HWKHS		7	N/A	--	3.9E-09	12.8	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1700	1700	--	--	1 hr
HWKHS		26	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1700	--	--	--	1 hr
HWKHS		34	N/A	--	6.0E-06	10.0	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1700	--	--	1.1E+00	1 hr

Accdent Freq. Receiving Site Agent Available and Released

SCEN-ARIO (B)	OP. (C)	NO. (D)	JA FREQ (E)	RANGE FACTOR (F)	AGENT AVAILABLE (G)	LBS SPILLED (H)	LBS DETONATED (I)	LBS EMITTED (J)	DURATION TIME (K)
HWKHS		5	2.9E-09	12.8	1700.0	1700.0			1HR
HWKHS		6	3.1E-10	31.1	1700.0			85.00	10MIN
HWKHS		7	3.9E-09	12.8	1700.0	1700.0			1HR
HWKHS		26	N/A	--	--	--	--	--	--
HWKHS		34	6.0E-06	10.0	1700.0	1700.0			1HR

DATE18-Aug-87 PAGE1

HANDLING ACCIDENTS - COLLOCATION PROCESSING OPTION (AIR TRANSPORT) (PER CONTAINER OR PALLET)

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	NO	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HAKHS	1	N/A	--	2.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	4.0E-08	1.3E+01	N/A	--	1700.0	1.7E+03	--	--	1 HR
HAPHC	1	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HAPVC	1	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	48.0	--	--	--	--
HAQGC	1	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HARGC	1	N/A	--	N/A	--	4.8E-08	1.3E+01	N/A	--	N/A	--	N/A	--	9.5E-08	1.3E+01	N/A	--	160.5	--	--	4.5E-01	1 HR
HARVC	1	N/A	--	N/A	--	4.8E-08	1.3E+01	N/A	--	N/A	--	N/A	--	9.5E-08	1.3E+01	N/A	--	150.0	--	--	1.6E-05	1 HR
HAKHF	2	N/A	--	5.2E-10	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1700.0	--	--	8.5E+01	10 MIN
HAPHC	3	N/A	--	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	N/A	--	93.6	--	--	2.1E-03	1 HR
HAPVC	3	N/A	--	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	N/A	--	48.0	--	--	2.1E-05	1 HR
HAQGC	3	N/A	--	N/A	--	5.0E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.0E-07	1.3E+01	N/A	--	87.0	--	--	5.6E-01	1 HR
HARGC	3	N/A	--	N/A	--	2.6E-06	1.3E+01	N/A	--	N/A	--	N/A	--	5.3E-06	1.3E+01	N/A	--	160.5	--	--	4.5E-01	1 HR
HARVC	3	N/A	--	N/A	--	2.6E-06	1.3E+01	N/A	--	N/A	--	N/A	--	5.3E-06	1.3E+01	N/A	--	150.0	--	--	1.6E-05	1 HR
HAKHS	4	N/A	--	6.7E-09	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	1.3E+01	N/A	--	1700.0	1.7E+03	--	--	1 HR
HAPHC	4	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HAPVC	4	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	48.0	--	--	--	--
HAQGC	4	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HARGC	4	N/A	--	N/A	--	3.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	6.2E-09	1.3E+01	N/A	--	160.5	--	--	4.5E-01	1 HR
HARVC	4	N/A	--	N/A	--	3.1E-09	1.3E+01	N/A	--	N/A	--	N/A	--	6.2E-09	1.3E+01	N/A	--	150.0	--	--	1.6E-05	1 HR
HAKHS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--	1700.0	1.7E+03	--	--	1 HR
HAPHS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	--	N/A	--	93.6	1.2E+01	--	--	1 HR
HAPVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	--	N/A	--	48.0	6.0E+00	--	--	1 HR
HAQGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	--	N/A	--	87.0	1.5E+01	--	--	1 HR
HARGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.9E-09	1.3E+01	N/A	--	160.5	1.1E+01	--	--	1 HR
HARVS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.9E-09	1.3E+01	N/A	--	150.0	1.0E+01	--	--	1 HR
HAKHF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.1E-10	3.1E+01	N/A	--	1700.0	--	--	8.5E+01	10 MIN
HAPHF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HAPVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	48.0	--	--	--	--
HAQGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HARGF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	3.1E+01	N/A	--	160.5	--	--	1.1E+00	10 MIN

HANDLING ACCIDENTS - COLLOCATION PROCESSING OPTION (AIR TRANSPORT) (PER CONTAINER OR PALLET)

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	NO	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HARVF	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	3.1E+01	N/A	--	150.0	--	--	2.5E-01	10 MIN
HAKHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-09	1.3E+01	N/A	--	1700.0	1.7E+03	--	--	1 HR
HAPHS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HAPVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	48.0	--	--	--	--
HAOGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HARGS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	1.3E+01	N/A	--	160.5	1.1E+01	--	--	1 HR
HARVS	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	1.3E+01	N/A	--	150.0	1.0E+01	--	--	1 HR
HAKHS	8	N/A	--	3.3E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-08	1.3E+01	N/A	--	3400.0	1.7E+03	--	--	1 HR
HAPHS	8	N/A	--	N/A	--	1.5E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.5E-08	1.3E+01	N/A	--	1404.0	1.2E+01	--	--	1 HR
HAPVS	8	N/A	--	N/A	--	1.5E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.5E-08	1.3E+01	N/A	--	720.0	6.0E+00	--	--	1 HR
HAOGS	8	N/A	--	N/A	--	1.5E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.5E-08	1.3E+01	N/A	--	870.0	1.5E+01	--	--	1 HR
HARGS	8	N/A	--	N/A	--	1.9E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.9E-08	1.3E+01	N/A	--	642.0	1.1E+01	--	--	1 HR
HARVS	8	N/A	--	N/A	--	1.9E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.9E-08	1.3E+01	N/A	--	600.0	1.0E+01	--	--	1 HR
HAKHF	9	N/A	--	1.0E-09	3.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-09	3.1E+01	N/A	--	3400.0	--	--	8.5E+01	10 MIN
HAPHF	9	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--	1404.0	--	--	5.8E-01	10 MIN
HAPVF	9	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--	720.0	--	--	1.5E-01	10 MIN
HAOGF	9	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--	N/A	--	N/A	--	1.9E-10	3.1E+01	N/A	--	870.0	--	--	1.5E+00	10 MIN
HARGF	9	N/A	--	N/A	--	8.4E-10	3.1E+01	N/A	--	N/A	--	N/A	--	8.4E-10	3.1E+01	N/A	--	642.0	--	--	1.1E+00	10 MIN
HARVF	9	N/A	--	N/A	--	8.4E-10	3.1E+01	N/A	--	N/A	--	N/A	--	8.4E-10	3.1E+01	N/A	--	600.0	--	--	2.5E-01	10 MIN
HAKHS	10	N/A	--	1.3E-08	1.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	1.3E+01	N/A	--	3400.0	1.7E+03	--	--	1 HR
HAPHS	10	N/A	--	N/A	--	2.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	2.4E-09	1.3E+01	N/A	--	1404.0	1.2E+01	--	--	1 HR
HAPVS	10	N/A	--	N/A	--	2.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	2.4E-09	1.3E+01	N/A	--	720.0	6.0E+00	--	--	1 HR
HAOGS	10	N/A	--	N/A	--	2.4E-09	1.3E+01	N/A	--	N/A	--	N/A	--	2.4E-09	1.3E+01	N/A	--	870.0	1.5E+01	--	--	1 HR
HARGS	10	N/A	--	N/A	--	1.1E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.1E-08	1.3E+01	N/A	--	642.0	1.1E+01	--	--	1 HR
HARVS	10	N/A	--	N/A	--	1.1E-08	1.3E+01	N/A	--	N/A	--	N/A	--	1.1E-08	1.3E+01	N/A	--	600.0	1.0E+01	--	--	1 HR
HAPHC	11	N/A	--	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	N/A	--	9.6E-10	2.6E+01	N/A	--	93.6	--	1.2E+01	7.0E-04	1 HR
HAPVC	11	N/A	--	N/A	--	4.8E-10	2.6E+01	N/A	--	N/A	--	N/A	--	9.6E-10	2.6E+01	N/A	--	48.0	--	6.0E+00	1.0E-05	1 HR
HAOGC	11	N/A	--	N/A	--	3.6E-10	2.6E+01	N/A	--	N/A	--	N/A	--	7.2E-10	2.6E+01	N/A	--	87.0	--	1.5E+01	1.7E-01	1 HR
HARGC	11	N/A	--	N/A	--	9.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	1.8E-09	2.6E+01	N/A	--	160.5	--	2.1E+01	1.0E+00	1 HR

DATE18-Aug-87 PAGE3

HANDLING ACCIDENTS - COLLOCATION PROCESSING OPTION (AIR TRANSPORT) (PER CONTAINER OR PALLET)

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	NO	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HARVC	11	N/A	--	N/A	--	9.0E-10	2.6E+01	N/A	--	N/A	--	N/A	--	1.8E-09	2.6E+01	N/A	--	150.0	--	2.0E+01	5.0E-06	1 HR
HAPHC	12	N/A	--	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.9E-11	2.6E+01	N/A	--	93.6	--	1.2E+01	7.0E-04	1 HR
HAPVC	12	N/A	--	N/A	--	3.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.9E-11	2.6E+01	N/A	--	48.0	--	6.0E+00	1.0E-05	1 HR
HAQGC	12	N/A	--	N/A	--	2.6E-11	2.6E+01	N/A	--	N/A	--	N/A	--	5.2E-11	2.6E+01	N/A	--	87.0	--	1.5E+01	1.7E-01	1 HR
HARGC	12	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.3E-10	2.6E+01	N/A	--	160.5	--	2.1E+01	1.0E+00	1 HR
HARVC	12	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.3E-10	2.6E+01	N/A	--	150.0	--	2.0E+01	5.0E-06	1 HR
HARGC	17	N/A	--	N/A	--	6.0E-13	2.6E+01	N/A	--	N/A	--	N/A	--	6.0E-13	2.6E+01	N/A	--	160.5	--	--	1.4E-01	1 HR
HARVC	17	N/A	--	N/A	--	6.0E-13	2.6E+01	N/A	--	N/A	--	N/A	--	6.0E-13	2.6E+01	N/A	--	150.0	--	--	4.7E-06	1 HR
HARGC	18	N/A	--	N/A	--	1.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	1.2E-12	2.6E+01	N/A	--	10.7	--	--	1.4E-01	1 HR
HARVC	18	N/A	--	N/A	--	1.2E-12	2.6E+01	N/A	--	N/A	--	N/A	--	1.2E-12	2.6E+01	N/A	--	10.0	--	--	4.7E-06	1 HR
HARGC	19	N/A	--	N/A	--	2.6E-14	3.1E+01	N/A	--	N/A	--	N/A	--	2.6E-14	3.1E+01	N/A	--	160.5	--	--	1.4E-01	1 HR
HARVC	19	N/A	--	N/A	--	2.6E-14	3.1E+01	N/A	--	N/A	--	N/A	--	2.6E-14	3.1E+01	N/A	--	150.0	--	--	4.7E-06	1 HR
HARGC	21	N/A	--	N/A	--	3.1E-10	3.1E+01	N/A	--	N/A	--	N/A	--	3.1E-10	3.1E+01	N/A	--	160.5	--	--	1.4E-01	1 HR
HARVC	21	N/A	--	N/A	--	3.1E-10	3.1E+01	N/A	--	N/A	--	N/A	--	3.1E-10	3.1E+01	N/A	--	150.0	--	--	4.7E-06	1 HR
HAPHC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--	93.6	5.8E+01	1.2E+01	--	1 HR
HAPVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	2.6E+01	N/A	--	48.0	3.0E+01	6.0E+00	--	1 HR
HAQGC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	87.0	7.3E+01	1.5E+01	--	1 HR
HARGC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-11	2.6E+01	N/A	--	160.5	1.4E+02	2.1E+01	--	1 HR
HARVC	22	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.7E-11	2.6E+01	N/A	--	150.0	1.3E+02	2.0E+01	--	1 HR
HAPHC	23	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--	1404.0	5.8E+01	1.2E+01	--	1 HR
HAPVC	23	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--	N/A	--	N/A	--	2.2E-11	2.6E+01	N/A	--	720.0	3.0E+01	6.0E+00	--	1 HR
HAQGC	23	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	870.0	7.3E+01	1.5E+01	--	1 HR
HARGC	23	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	642.0	1.4E+02	2.1E+01	--	1 HR
HARVC	23	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.1E-11	2.6E+01	N/A	--	600.0	1.3E+02	2.0E+01	--	1 HR
HAPHC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--	93.6	5.8E+01	1.2E+01	--	1 HR
HAPVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-11	2.6E+01	N/A	--	48.0	3.0E+01	6.0E+00	--	1 HR
HAQGC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	87.0	7.3E+01	1.5E+01	--	1 HR
HARGC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-11	2.6E+01	N/A	--	160.5	1.4E+02	2.1E+01	--	1 HR
HARVC	24	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-11	2.6E+01	N/A	--	150.0	1.3E+02	2.0E+01	--	1 HR

DATE18-Aug-87 PAGE4

HANDLING ACCIDENTS - COLLOCATION PROCESSING OPTION (AIR TRANSPORT) (PER CONTAINER OR PALLET)

Accident Frequencies and Range Factors																		Agent Available and Released				
SCEN-ARIO	NO	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
HAPHC	25	N/A	--	N/A	--	1.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.5E-11	2.6E+01	N/A	--	1404.0	5.8E+01	1.2E+01	--	1 HR
HAPVC	25	N/A	--	N/A	--	1.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	1.5E-11	2.6E+01	N/A	--	720.0	3.0E+01	6.0E+00	--	1 HR
HAOGC	25	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	870.0	7.3E+01	1.5E+01	--	1 HR
HARGC	25	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	642.0	1.4E+02	2.1E+01	--	1 HR
HARVC	25	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	N/A	--	N/A	--	7.7E-12	2.6E+01	N/A	--	600.0	1.3E+02	2.0E+01	--	1 HR
HAKHF	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	1700.0	--	--	--	--
HAPHC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	93.6	--	--	--	--
HAPVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	48.0	--	--	--	--
HAOGC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	87.0	--	--	--	--
HARGC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	160.5	--	--	--	--
HARVC	26	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	150.0	--	--	--	--
HAKHF	27	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	3400.0	--	--	--	--
HAPHC	27	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	1404.0	--	--	--	--
HAPVC	27	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	720.0	--	--	--	--
HAOGC	27	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	870.0	--	--	--	--
HARGC	27	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	642.0	--	--	--	--
HARVC	27	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	600.0	--	--	--	--
HARGC	29	N/A	--	N/A	--	9.0E-09	2.6E+01	N/A	--	N/A	--	N/A	--	9.0E-09	2.6E+01	N/A	--	160.5	--	2.1E+01	1.0E+00	1 HR
HARVC	29	N/A	--	N/A	--	9.0E-09	2.6E+01	N/A	--	N/A	--	N/A	--	9.0E-09	2.6E+01	N/A	--	150.0	--	2.0E+01	5.0E-06	1 HR
HARGC	30	N/A	--	N/A	--	1.8E-08	2.6E+01	N/A	--	N/A	--	N/A	--	1.8E-08	2.6E+01	N/A	--	10.7	--	1.1E+01	--	INST
HARVC	30	N/A	--	N/A	--	1.8E-08	2.6E+01	N/A	--	N/A	--	N/A	--	1.8E-08	2.6E+01	N/A	--	10.0	--	1.0E+01	--	INST
HARGC	31	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	160.5	--	2.1E+01	1.0E+00	1 HR
HARVC	31	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	N/A	--	N/A	--	6.5E-11	2.6E+01	N/A	--	150.0	--	2.0E+01	5.0E-06	1 HR
HARGS	32	N/A	--	N/A	--	1.0E-03	1.0E+01	N/A	--	N/A	--	N/A	--	1.0E-03	1.0E+01	N/A	--	642.0	--	--	NEGL	--
HARVS	32	N/A	--	N/A	--	1.0E-03	1.0E+01	N/A	--	N/A	--	N/A	--	1.0E-03	1.0E+01	N/A	--	600.0	--	--	NEGL	

I.1.4. PLANT OPERATIONS

The following tables list the results for internal and external accidents during plant operations.

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
F01 Tornado-generated missile puncture/crush munitions in the MHI.										
[illegible]	1	N/A	--	1.5E-16	94	7040.0	--	--	5.30E-01	2 HR
[illegible]	1	8.0E-13	94	1.3E-15	94	4608.0	--	--	2.40E-02	2 HR
[illegible]	1	2.1E-13	94	4.3E-16	94	614.4	--	--	5.30E-01	2 HR
[illegible]	1	2.1E-13	94	4.3E-16	94	1228.8	--	--	2.40E-02	2 HR
[illegible]	1	N/A	--	2.0E-16	94	24000.0	--	--	1.60E+00	2 HR
[illegible]	1	1.1E-13	94	2.0E-16	94	27200.0	--	--	3.00E-01	2 HR
[illegible]	1	1.1E-13	94	2.0E-16	94	25600.0	--	--	3.00E-04	2 HR
[illegible]	1	[illegible]	94	1.5E-15	94	6048.0	--	--	2.00E-04	2 HR
[illegible]	1	[illegible]	94	5.7E-16	94	832.0	--	--	5.30E-01	2 HR
[illegible]	1	[illegible]	94	5.7E-16	94	1497.6	--	--	2.40E-02	2 HR
[illegible]	1	[illegible]	94	5.7E-16	94	768.0	--	--	2.00E-04	2 HR
[illegible]	1	[illegible]	94	6.8E-16	94	1392.0	--	--	5.30E-01	2 HR
[illegible]	1	N/A	-	6.8E-16	94	1392.0	--	--	2.00E-04	2 HR
[illegible]	1	[illegible]	94	1.4E-15	94	2568.0	--	--	5.30E-01	2 HR
[illegible]	1	8.6E-13	94	1.4E-15	94	2400.0	-	--	2.00E-04	2 HR
[illegible]	1	N/A	--	3.7E-16	94	21696.0	--	--	3.00E-04	2 HR
F02 Tornado-generated missile detonate munitions in the MHI.										
[illegible]	2	1.7E-13	99	2.7E-16	99	4608.0	--	6.00E+00	8.00E-03	2 HR
[illegible]	2	4.3E-14	99	9.1E-17	99	614.4	--	1.60E+00	1.60E-01	2 HR
[illegible]	2	4.3E-14	99	9.1E-17	99	1228.8	--	3.20E+00	4.00E-03	2 HR
[illegible]	2	2.0E-13	99	3.2E-16	99	6048.0	--	3.15E+01	2.59E-01	2 HR
[illegible]	2	[illegible]	99	1.2E-16	99	832.0	--	6.50E+00	5.00E-03	2 HR
[illegible]	2	[illegible]	99	1.2E-16	99	1497.6	--	1.17E+01	4.00E-05	2 HR
[illegible]	2	[illegible]	99	1.2E-16	99	768.0	--	6.00E+00	4.38E-01	2 HR
[illegible]	2	6.0E-14	99	1.5E-16	99	1392.0	--	1.45E+01	5.00E-05	2 HR
[illegible]	2	N/A	--	1.5E-16	99	1392.0	--	1.45E+01	7.67E-01	2 HR
[illegible]	2	1.9E-13	99	3.0E-16	99	2568.0	--	2.14E+01	6.00E-05	2 HR
[illegible]	2	1.9E-13	99	3.0E-16	99	2400.0	--	2.00E+01	N/A	2 HR
F03 Tornado-generated missile puncture/crush munitions in the UPA.										

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
1.5E-16	94	7040.0	--	--	5.30E-01	2 HR
1.3E-15	94	4608.0	--	--	2.40E-02	2 HR
4.3E-16	94	614.4	--	--	5.30E-01	2 HR
4.3E-16	94	1228.8	--	--	2.40E-02	2 HR
2.0E-16	94	24000.0	--	--	1.60E+00	2 HR
2.0E-16	94	27200.0	--	--	3.00E-01	2 HR
2.0E-16	94	25600.0	--	--	3.00E-04	2 HR
1.5E-15	94	6048.0	--	--	2.00E-04	2 HR
5.7E-16	94	832.0	--	--	5.30E-01	2 HR
5.7E-16	94	1497.6	--	--	2.40E-02	2 HR
5.7E-16	94	768.0	--	--	2.00E-04	2 HR
6.8E-16	94	1392.0	--	--	5.30E-01	2 HR
6.8E-16	94	1392.0	--	--	2.00E-04	2 HR
1.4E-15	94	2568.0	--	--	5.30E-01	2 HR
1.4E-15	94	2400.0	--	--	2.00E-04	2 HR
3.7E-16	94	21696.0	--	--	3.00E-04	2 HR
2.7E-16	99	4608.0	--	6.00E+00	8.00E-03	2 HR
9.1E-17	99	614.4	--	1.60E+00	1.60E-01	2 HR
9.1E-17	99	1228.8	--	3.20E+00	4.00E-03	2 HR
3.2E-16	99	6048.0	--	3.15E+01	2.59E-01	2 HR
1.2E-16	99	832.0	--	6.50E+00	5.00E-03	2 HR
1.2E-16	99	1497.6	--	1.17E+01	4.00E-05	2 HR
1.2E-16	99	768.0	--	6.00E+00	4.38E-01	2 HR
1.5E-16	99	1392.0	--	1.45E+01	5.00E-05	2 HR
1.5E-16	99	1392.0	--	1.45E+01	7.67E-01	2 HR
3.0E-16	99	2568.0	--	2.14E+01	6.00E-05	2 HR
3.0E-16	99	2400.0	--	2.00E+01	N/A	2 HR

File: FLTCOL.WK1, 20-Aug-87 PAGE2

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME	TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
FOBGC	3	N/A	--	2.1E-15	94	2640.0	--	--	5.30E-01	1 HR	2.1E-15	94	2640.0	--	--	5.30E-01	1 HR
FODHC	3	6.6E-12	94	7.9E-15	94	1728.0	--	--	2.40E-02	1 HR	7.9E-15	94	1728.0	--	--	2.40E-02	1 HR
FOCGC	3	2.3E-12	94	2.7E-15	94	230.4	--	--	5.30E-01	1 HR	2.7E-15	94	230.4	--	--	5.30E-01	1 HR
FOCHC	3	2.3E-12	94	2.7E-15	94	460.8	--	--	2.40E-02	1 HR	2.7E-15	94	460.8	--	--	2.40E-02	1 HR
FOFGC	3	N/A	--	3.6E-15	94	9000.0	--	--	1.44E+00	1 HR	3.6E-15	94	9000.0	--	--	1.44E+00	1 HR
FOFHC	3	3.6E-12	94	3.6E-15	94	10200.0	--	--	7.00E-02	1 HR	3.6E-15	94	10200.0	--	--	7.00E-02	1 HR
FOFVC	3	3.6E-12	94	3.6E-15	94	9600.0	--	--	NEGL	1 HR	3.6E-15	94	9600.0	--	--	NEGL	1 HR
FOMVC	3	6.0E-13	94	9.2E-15	94	2268.0	--	--	2.00E-04	1 HR	9.2E-15	94	2268.0	--	--	2.00E-04	1 HR
FOPGC	3	3.5E-12	94	4.1E-15	94	312.0	--	--	5.30E-01	1 HR	4.1E-15	94	312.0	--	--	5.30E-01	1 HR
FOPHC	3	3.5E-12	94	4.1E-15	94	561.6	--	--	2.40E-02	1 HR	4.1E-15	94	561.6	--	--	2.40E-02	1 HR
FOPVC	3	3.5E-12	94	4.1E-15	94	288.0	--	--	2.00E-04	1 HR	4.1E-15	94	288.0	--	--	2.00E-04	1 HR
FOQGC	3	3.5E-12	94	4.1E-15	94	522.0	--	--	5.30E-01	1 HR	4.1E-15	94	522.0	--	--	5.30E-01	1 HR
FOQVC	3	N/A	--	4.1E-15	94	522.0	--	--	2.00E-04	1 HR	4.1E-15	94	522.0	--	--	2.00E-04	1 HR
FORGC	3	7.1E-12	94	8.5E-15	94	963.0	--	--	5.30E-01	1 HR	8.5E-15	94	963.0	--	--	5.30E-01	1 HR
FORVC	3	7.1E-12	94	8.5E-15	94	900.0	--	--	2.00E-04	1 HR	8.5E-15	94	900.0	--	--	2.00E-04	1 HR
FOSVC	3	N/A	--	1.5E-14	94	8136.0	--	--	NEGL	1 HR	1.5E-14	94	8136.0	--	--	NEGL	1 HR
FO4 - Tornado-generated missile detonate munitions in the UPA.																	
FODHC	4	7.0E-13	94	8.4E-16	94	1728.0	--	6.00E+00	NEGL	2 HR	8.4E-16	94	1728.0	--	6.00E+00	NEGL	2 HR
FOCGC	4	2.4E-13	94	2.9E-16	94	230.4	--	1.60E+00	1.32E-01	2 HR	2.9E-16	94	230.4	--	1.60E+00	1.32E-01	2 HR
FOCHC	4	2.4E-13	94	2.9E-16	94	460.8	--	3.20E+00	NEGL	2 HR	2.9E-16	94	460.8	--	3.20E+00	NEGL	2 HR
FOMVC	4	1.3E-12	94	9.8E-16	94	2268.0	--	3.15E+01	NEGL	2 HR	9.8E-16	94	2268.0	--	3.15E+01	NEGL	2 HR
FOFGC	4	3.7E-13	94	4.4E-16	94	312.0	--	6.50E+00	2.31E-01	2 HR	4.4E-16	94	312.0	--	6.50E+00	2.31E-01	2 HR
FOFHC	4	3.7E-13	94	4.4E-16	94	561.6	--	1.17E+01	NEGL	2 HR	4.4E-16	94	561.6	--	1.17E+01	NEGL	2 HR
FOPVC	4	3.7E-13	94	4.4E-16	94	288.0	--	6.00E+00	NEGL	2 HR	4.4E-16	94	288.0	--	6.00E+00	NEGL	2 HR
FOQGC	4	3.7E-13	94	4.4E-16	94	522.0	--	1.45E+01	4.10E-01	2 HR	4.4E-16	94	522.0	--	1.45E+01	4.10E-01	2 HR
FOQVC	4	N/A	--	4.4E-16	94	522.0	--	1.45E+01	NEGL	2 HR	4.4E-16	94	522.0	--	1.45E+01	NEGL	2 HR
FORGC	4	7.5E-13	94	4.4E-16	94	963.0	--	2.14E+01	7.19E-01	2 HR	4.4E-16	94	963.0	--	2.14E+01	7.19E-01	2 HR
FORVC	4	0.0E+00	94	4.4E-16	94	900.0	--	2.00E+01	NEGL	2 HR	4.4E-16	94	900.0	--	2.00E+01	NEGL	2 HR
FO5 - Tornado-generated missile damages the agent piping system between the BDS and TOX at TEAD (bulk-only facility).																	
FOAGS	5	N/A	--	2.3E-11	94	--	5.48E+02	--	--	1 HR	2.3E-11	94	--	5.48E+02	--	--	1 HR

File: FLTCOL.WK1, 20-Aug-87 PAGE3

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
FOAHS	5	N/A	--	0.0E+00	94	--	6.38E+02	--	--	1 HR
FCAVS	5	N/A	--	0.0E+00	94	--	5.07E+02	--	--	1 HR

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
0.0E+00	94	--	6.38E+02	--	--	1 HR
0.0E+00	94	--	5.07E+02	--	--	1 HR

Notes:

1. Frequency unit = events/operating year
2. Scenarios 5 applies only to the TEAD bulk-only facility

File: PLTCOL.WK1, 20-Aug-87 PAGE1

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
F06 - Meteorite strikes the MHI.										
FOBGF	6	N/A	--	1.4E-15	26	7040.0	--	--	7.04E+02	1 HR
FODHC	6	9.8E-16	26	9.8E-16	26	4608.0	--	1.15E+03	1.73E+02	20 MIN
FOCGC	6	6.0E-16	26	6.0E-16	26	614.4	--	1.54E+02	4.61E+01	20 MIN
FOCHC	6	6.0E-16	26	6.0E-16	26	1228.8	--	3.07E+02	4.61E+01	20 MIN
FOKGF	6	N/A	--	2.0E-15	26	24000.0	--	--	2.40E+03	1 HR
FOKHF	6	2.0E-15	26	2.0E-15	26	27200.0	--	--	1.36E+03	1 HR
FOKVF	6	2.0E-15	26	2.0E-15	26	25600.0	--	--	6.40E+02	1 HR
FOMVC	6	1.5E-15	26	1.5E-15	26	6048.0	--	1.51E+03	1.13E+02	20 MIN
FOPGC	6	4.6E-16	26	4.6E-16	26	832.0	--	2.08E+02	6.24E+01	20 MIN
FOPHC	6	4.6E-16	26	4.6E-16	26	1497.6	--	3.74E+02	5.62E+01	20 MIN
FOPVC	6	4.6E-16	26	4.6E-16	26	768.0	--	1.92E+02	1.44E+01	20 MIN
FOQGC	6	4.6E-16	26	4.6E-16	26	1392.0	--	3.48E+02	1.04E+02	20 MIN
FOQVC	6	N/A	--	4.6E-16	26	1392.0	--	3.48E+02	2.61E+01	20 MIN
FORGC	6	2.1E-15	26	2.1E-15	26	2568.0	--	6.42E+02	1.93E+02	20 MIN
FORVC	6	3.4E-15	26	2.1E-15	26	2400.0	--	6.00E+02	4.50E+01	20 MIN
FOSVF	6	N/A	--	3.4E-15	26	21696.0	--	--	5.42E+02	1 HR
F07 - Meteorite strikes the UFA.										
FOBGF	7	N/A	--	2.9E-12	26	2640.0	--	--	2.64E+02	1 HR
FODHC	7	2.0E-12	26	2.0E-12	26	1728.0	--	4.32E+02	6.48E+01	20 MIN
FOCGC	7	1.1E-12	26	1.1E-12	26	230.4	--	5.76E+01	1.73E+01	20 MIN
FOCHC	7	1.1E-12	26	1.1E-12	26	460.8	--	1.15E+02	1.73E+01	20 MIN
FOKGF	7	N/A	--	4.0E-12	26	9000.0	--	--	9.00E+02	1 HR
FOKHF	7	4.0E-12	26	4.0E-12	26	10200.0	--	--	5.10E+02	1 HR
FOKVF	7	4.0E-12	26	4.0E-12	26	9600.0	--	--	2.40E+02	1 HR
FOMVC	7	2.9E-12	26	2.9E-12	26	2268.0	--	5.67E+02	4.25E+01	20 MIN
FOPGC	7	8.8E-13	26	8.8E-13	26	312.0	--	7.80E+01	2.34E+01	20 MIN
FOPHC	7	8.8E-13	26	8.8E-13	26	561.6	--	1.40E+02	2.11E+01	20 MIN
FOPVC	7	8.8E-13	26	8.8E-13	26	288.0	--	7.20E+01	5.40E+00	20 MIN
FOQGC	7	8.8E-13	26	8.8E-13	26	522.0	--	1.31E+02	3.92E+01	20 MIN

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
FOBGF	1.4E-15	26	7040.0	--	--	7.04E+02	1 HR
FODHC	9.8E-16	26	4608.0	--	1.15E+03	1.73E+02	20 MIN
FOCGC	6.0E-16	26	614.4	--	1.54E+02	4.61E+01	20 MIN
FOCHC	6.0E-16	26	1228.8	--	3.07E+02	4.61E+01	20 MIN
FOKGF	2.0E-15	26	24000.0	--	--	2.40E+03	1 HR
FOKHF	2.0E-15	26	27200.0	--	--	1.36E+03	1 HR
FOKVF	2.0E-15	26	25600.0	--	--	6.40E+02	1 HR
FOMVC	1.5E-15	26	6048.0	--	1.51E+03	1.13E+02	20 MIN
FOPGC	4.6E-16	26	832.0	--	2.08E+02	6.24E+01	20 MIN
FOPHC	4.6E-16	26	1497.6	--	3.74E+02	5.62E+01	20 MIN
FOPVC	4.6E-16	26	768.0	--	1.92E+02	1.44E+01	20 MIN
FOQGC	4.6E-16	26	1392.0	--	3.48E+02	1.04E+02	20 MIN
FOQVC	4.6E-16	26	1392.0	--	3.48E+02	2.61E+01	20 MIN
FORGC	2.1E-15	26	2568.0	--	6.42E+02	1.93E+02	20 MIN
FORVC	2.1E-15	26	2400.0	--	6.00E+02	4.50E+01	20 MIN
FOSVF	3.4E-15	26	21696.0	--	--	5.42E+02	1 HR
FOBGF	2.9E-12	26	2640.0	--	--	2.64E+02	1 HR
FODHC	2.0E-12	26	1728.0	--	4.32E+02	6.48E+01	20 MIN
FOCGC	1.1E-12	26	230.4	--	5.76E+01	1.73E+01	20 MIN
FOCHC	1.1E-12	26	460.8	--	1.15E+02	1.73E+01	20 MIN
FOKGF	4.0E-12	26	9000.0	--	--	9.00E+02	1 HR
FOKHF	4.0E-12	26	10200.0	--	--	5.10E+02	1 HR
FOKVF	4.0E-12	26	9600.0	--	--	2.40E+02	1 HR
FOMVC	2.9E-12	26	2268.0	--	5.67E+02	4.25E+01	20 MIN
FOPGC	8.8E-13	26	312.0	--	7.80E+01	2.34E+01	20 MIN
FOPHC	8.8E-13	26	561.6	--	1.40E+02	2.11E+01	20 MIN
FOPVC	8.8E-13	26	288.0	--	7.20E+01	5.40E+00	20 MIN
FOQGC	8.8E-13	26	522.0	--	1.31E+02	3.92E+01	20 MIN

File: PLTCOL.WK1, 20-Aug-87 PAGE2

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
FO0?C	7	N/A	--	8.8E-13	26	522.0	--	1.31E+02	9.79E+00	20 MIN
FORGC	7	4.0E-12	26	4.0E-12	26	963.0	--	2.41E+02	7.22E+01	20 MIN
FORVC	7	4.0E-12	26	4.0E-12	26	900.0	--	2.25E+02	1.69E+01	20 MIN
FOSVF	7	N/A	--	6.7E-12	26	8136.0	--	--	2.03E+02	1 HR
F07A - Meteorite strikes the TOX.										
FOAGF	7A	3.4E-13	26	3.4E-13	26	16.4	--	--	1.64E+00	1 HR
FOAHF	7A	3.4E-13	26	3.4E-13	26	19.1	--	--	9.53E-01	1 HR
FOAVF	7A	3.4E-13	26	3.4E-13	26	15.1	--	--	3.78E-01	1 HR
F08 - Meteorite strikes the agent piping system between the BDS and TOX at TEAD (bulk-only facility).										
FOAGF	8	N/A	--	3.0E-11	17	--	--	--	5.48E+01	10 MIN
FOAHF	8	N/A	--	3.0E-11	17	--	--	--	3.19E+01	10 MIN
FOAVF	8	N/A	--	3.0E-11	17	--	--	--	1.27E+01	10 MIN

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
8.8E-13	26	522.0	--	1.31E+02	9.79E+00	20 MIN
4.0E-12	26	963.(	--	2.41E+02	7.22E+01	20 MIN
4.0E-12	26	900.0	--	2.25E+02	1.69E+01	20 MIN
6.7E-12	26	8136.0	--	--	2.03E+02	1 HR
3.4E-13	26	16.4	--	--	1.64E+00	1 HR
3.4E-13	26	19.1	--	--	9.53E-01	1 HR
3.4E-13	26	15.1	--	--	3.78E-01	1 HR
3.0E-11	17	--	--	--	5.48E+01	10 MIN
3.0E-11	17	--	--	--	3.19E+01	10 MIN
3.0E-11	17	--	--	--	1.27E+01	10 MIN

Notes:

1. Frequency unit = events/operating year
2. Scenarios 8 applies only to the TEAD bulk-only facility

File: PLTCOL.WK1, 20-Aug-87 PAGE1

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
F09 - Direct large aircraft crash onto the MHI; no fire										
FOBGS	9	N/A	--	1.2E-11	10	7040.0	2.11E+03	--	--	6 HR
FODHC	9	2.6E-10	10	1.2E-11	10	4608.0	1.15E+03	2.30E+02	--	6 HR
FOCGC	9	2.6E-10	10	1.2E-11	10	614.4	1.54E+02	3.07E+01	--	6 HR
FOCHC	9	2.6E-10	10	1.2E-11	10	1228.8	3.07E+02	6.14E+01	--	6 HR
FOKGS	9	N/A	--	1.2E-11	10	24000.0	7.20E+03	--	--	6 HR
FOKHS	9	2.6E-10	10	1.2E-11	10	27200.0	8.16E+03	--	--	6 HR
FOKVS	9	2.6E-10	10	1.2E-11	10	25600.0	7.68E+03	--	--	6 HR
FOMVC	9	2.6E-10	10	1.2E-11	10	6048.0	2.42E+03	3.02E+02	--	6 HR
FOFGC	9	2.6E-10	10	1.2E-11	10	832.0	2.08E+02	4.16E+01	--	6 HR
FOFHC	9	2.6E-10	10	1.2E-11	10	1497.6	3.74E+02	7.49E+01	--	6 HR
FOFVC	9	2.6E-10	10	1.2E-11	10	768.0	1.92E+02	3.84E+01	--	6 HR
FOGGC	9	2.6E-10	10	1.2E-11	10	1392.0	3.48E+02	6.96E+01	--	6 HR
FOGVC	9	N/A	--	1.2E-11	10	1392.0	3.48E+02	6.96E+01	--	6 HR
FORGC	9	2.6E-10	10	1.2E-11	10	2568.0	1.03E+03	1.28E+02	--	6 HR
FORVC	9	2.6E-10	10	1.2E-11	10	2400.0	9.60E+02	1.20E+02	--	6 HR
FOSVS	9	N/A	--	1.2E-11	10	21696.0	6.51E+03	--	--	6 HR
F010 - Direct large aircraft crash onto the MHI; fire not contained in 0.5 hours										
FOBGF	10	N/A	--	9.8E-12	10	7040.0	--	--	7.04E+02	1 HR
FODHC	10	2.2E-10	10	9.8E-12	10	4608.0	--	1.15E+03	1.73E+02	20 MIN
FOCGC	10	2.2E-10	10	9.8E-12	10	614.4	--	1.54E+02	4.61E+01	20 MIN
FOCHC	10	2.2E-10	10	9.8E-12	10	1228.8	--	3.07E+02	4.61E+01	20 MIN
FOKGF	10	N/A	--	9.8E-12	10	24000.0	--	--	2.40E+03	1 HR
FOKHF	10	2.2E-10	10	9.8E-12	10	27200.0	--	--	1.36E+03	1 HR
FOKVF	10	2.2E-10	10	9.8E-12	10	25600.0	--	--	6.40E+02	1 HR
FOMVC	10	2.2E-10	10	9.8E-12	10	6048.0	--	1.51E+03	1.13E+02	20 MIN
FOPGC	10	2.2E-10	10	9.8E-12	10	832.0	--	2.08E+02	6.24E+01	20 MIN
FOFHC	10	2.2E-10	10	9.8E-12	10	1497.6	--	3.74E+02	5.62E+01	20 MIN
FOFVC	10	2.2E-10	10	9.8E-12	10	768.0	--	1.92E+02	1.44E+01	20 MIN
FOGGC	10	2.2E-10	10	9.8E-12	10	1392.0	--	3.48E+02	1.04E+02	20 MIN

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

TEAD MDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
1.2E-11	10	7040.0	2.11E+03	--	--	6 HR
1.2E-11	10	4608.0	1.15E+03	2.30E+02	--	6 HR
1.2E-11	10	614.4	1.54E+02	3.07E+01	--	6 HR
1.2E-11	10	1228.8	3.07E+02	6.14E+01	--	6 HR
1.2E-11	10	24000.0	7.20E+03	--	--	6 HR
1.2E-11	10	27200.0	8.16E+03	--	--	6 HR
1.2E-11	10	25600.0	7.68E+03	--	--	6 HR
1.2E-11	10	6048.0	2.42E+03	3.02E+02	--	6 HR
1.2E-11	10	832.0	2.08E+02	4.16E+01	--	6 HR
1.2E-11	10	1497.6	3.74E+02	7.49E+01	--	6 HR
1.2E-11	10	768.0	1.92E+02	3.84E+01	--	6 HR
1.2E-11	10	1392.0	3.48E+02	6.96E+01	--	6 HR
1.2E-11	10	1392.0	3.48E+02	6.96E+01	--	6 HR
1.2E-11	10	2568.0	1.03E+03	1.28E+02	--	6 HR
1.2E-11	10	2400.0	9.60E+02	1.20E+02	--	6 HR
1.2E-11	10	21696.0	6.51E+03	--	--	6 HR
9.8E-12	10	7040.0	--	--	7.04E+02	1 HR
9.8E-12	10	4608.0	--	1.15E+03	1.73E+02	20 MIN
9.8E-12	10	614.4	--	1.54E+02	4.61E+01	20 MIN
9.8E-12	10	1228.8	--	3.07E+02	4.61E+01	20 MIN
9.8E-12	10	24000.0	--	--	2.40E+03	1 HR
9.8E-12	10	27200.0	--	--	1.36E+03	1 HR
9.8E-12	10	25600.0	--	--	6.40E+02	1 HR
9.8E-12	10	6048.0	--	1.51E+03	1.13E+02	20 MIN
9.8E-12	10	832.0	--	2.08E+02	6.24E+01	20 MIN
9.8E-12	10	1497.6	--	3.74E+02	5.62E+01	20 MIN
9.8E-12	10	768.0	--	1.92E+02	1.44E+01	20 MIN
9.8E-12	10	1392.0	--	3.48E+02	1.04E+02	20 MIN

File: FLTCOL.WK1, 20-Aug-87 PAGE2

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
F0QVC	10	N/A	--	9.8E-12	10	1392.0	--	3.48E+02	2.61E+01	20 MIN
F0RGC	10	2.2E-10	10	9.8E-12	10	2568.0	--	6.42E+02	1.93E+02	20 MIN
F0RVC	10	2.2E-10	10	9.8E-12	10	2400.0	--	6.00E+02	4.50E+01	20 MIN
F0SVF	10	N/A	--	9.8E-12	10	21696.0	--	--	5.42E+02	1 HR
F011 - Direct large aircraft crash onto the MHI; fire contained in 0.5 hours										
F0BGF	11	N/A	--	3.3E-15	13	7040.0	--	--	2.11E+02	1 HR
F0KGF	11	N/A	--	3.3E-15	13	24000.0	--	--	7.20E+02	1 HR
F0KHF	11	7.3E-14	13	3.3E-15	13	27200.0	--	--	4.08E+02	1 HR
F0KVF	11	7.3E-14	13	3.3E-15	13	25600.0	--	--	1.92E+02	1 HR
F0SVF	11	N/A	--	3.3E-15	13	21696.0	--	--	1.63E+02	1 HR
F012 - Direct large aircraft crash damages the MDB; no fire										
F0BGS	12	N/A	--	3.5E-10	10	2656.4	2.22E+03	--	--	6 HR
F0DHC	12	7.7E-09	10	3.5E-10	10	1747.1	1.22E+03	2.59E+02	--	6 HR
F0CGC	12	7.7E-09	10	3.5E-10	10	246.8	1.73E+02	3.46E+01	--	6 HR
F0CHC	12	7.7E-09	10	3.5E-10	10	479.9	3.36E+02	6.91E+01	--	6 HR
F0FGS	12	N/A	--	3.5E-10	10	9016.4	7.52E+03	--	--	6 HR
F0KHS	12	7.7E-09	10	3.5E-10	10	10219.1	8.52E+03	--	--	6 HR
F0KVS	12	7.7E-09	10	3.5E-10	10	9615.1	8.02E+03	--	--	6 HR
F0MVC	12	7.7E-09	10	3.5E-10	10	2283.1	1.60E+03	3.40E+02	--	6 HR
F0FGC	12	7.7E-09	10	3.5E-10	10	328.4	2.30E+02	4.68E+01	--	6 HR
F0FHC	12	7.7E-09	10	3.5E-10	10	580.7	4.06E+02	8.42E+01	--	6 HR
F0FVC	12	7.7E-09	10	3.5E-10	10	303.1	2.12E+02	4.32E+01	--	6 HR
F0WGC	12	7.7E 09	10	3.5E-10	10	538.4	3.77E+02	7.83E+01	--	6 HR
F0QVC	12	N/A	--	3.5E-10	10	537.1	3.76E+02	7.83E+01	--	6 HR
F0RGC	12	7.7E-09	10	3.5E-10	10	979.3	6.86E+02	1.44E+02	--	6 HR
F0RVC	12	7.7E-09	10	3.5E-10	10	915.1	6.41E+02	1.35E+02	--	6 HR
F0SVS	12	N/A	--	3.5E-10	10	8151.1	6.80E+03	--	--	6 HR
F013 - Direct large aircraft crash damages the MDB; fire not contained in 0.5 hours										
F0BGF	13	N/A	--	2.9E-10	10	2656.4	--	--	2.66E+02	1 HR
F0DHC	13	6.3E-09	10	2.9E-10	10	1747.1	--	4.32E+02	6.55E+01	20 MIN

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
9.8E-12	10	1392.0	--	3.48E+02	2.61E+01	20 MIN
9.8E-12	10	2568.0	--	6.42E+02	1.93E+02	20 MIN
9.8E-12	10	2400.0	--	6.00E+02	4.50E+01	20 MIN
9.8E-12	10	21696.0	--	--	5.42E+02	1 HR
3.3E-15	13	7040.0	--	--	2.11E+02	1 HR
3.3E-15	13	24000.0	--	--	7.20E+02	1 HR
3.3E-15	13	27200.0	--	--	4.08E+02	1 HR
3.3E-15	13	25600.0	--	--	1.92E+02	1 HR
3.3E-15	13	21696.0	--	--	1.63E+02	1 HR
3.5E-10	10	2656.4	2.22E+03	--	--	6 HR
3.5E-10	10	1747.1	1.22E+03	2.59E+02	--	6 HR
3.5E-10	10	246.8	1.73E+02	3.46E+01	--	6 HR
3.5E-10	10	479.9	3.36E+02	6.91E+01	--	6 HR
3.5E-10	10	9016.4	7.52E+03	--	--	6 HR
3.5E-10	10	10219.1	8.52E+03	--	--	6 HR
3.5E-10	10	9615.1	8.02E+03	--	--	6 HR
3.5E-10	10	2283.1	1.60E+03	3.40E+02	--	6 HR
3.5E-10	10	328.4	2.30E+02	4.68E+01	--	6 HR
3.5E-10	10	580.7	4.06E+02	8.42E+01	--	6 HR
3.5E-10	10	303.1	2.12E+02	4.32E+01	--	6 HR
3.5E-10	10	538.4	3.77E+02	7.83E+01	--	6 HR
3.5E-10	10	537.1	3.76E+02	7.83E+01	--	6 HR
3.5E-10	10	979.3	6.86E+02	1.44E+02	--	6 HR
3.5E-10	10	915.1	6.41E+02	1.35E+02	--	6 HR
3.5E-10	10	8151.1	6.80E+03	--	--	6 HR
2.9E-10	10	2656.4	--	--	2.66E+02	1 HR
2.9E-10	10	1747.1	--	4.32E+02	6.55E+01	20 MIN

File: FLTCOL.WK1, 20-Aug-87 PAGE3

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD NDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
FOCGC	13	6.3E-09	10	2.9E-10	10	246.8	--	5.76E+01	1.85E+01	20 MIN
FOCHC	13	6.3E-09	10	2.9E-10	10	479.9	--	1.15E+02	1.80E+01	20 MIN
FOKGF	13	N/A	--	2.9E-10	10	9016.4	--	--	9.02E+02	1 HR
FOKHF	13	6.3E-09	10	2.9E-10	10	10219.1	--	--	5.11E+02	1 HR
FOKVF	13	6.3E-09	10	2.9E-10	10	9615.1	--	--	2.40E+02	1 HR
FOMVC	13	6.3E-09	10	2.9E-10	10	2283.1	--	5.67E+02	4.28E+01	20 MIN
FOFGC	13	6.3E-09	10	2.9E-10	10	328.4	--	7.80E+01	2.46E+01	20 MIN
FOFH	13	6.3E-09	10	2.9E-10	10	580.7	--	1.40E+02	2.18E+01	20 MIN
FOFVC	13	6.3E-09	10	2.9E-10	10	303.1	--	7.20E+01	5.68E+00	20 MIN
FOGGC	13	6.3E-09	10	2.9E-10	10	538.4	--	1.31E+02	4.04E+01	20 MIN
FOGV	13	N/A		2.9E-10	10	537.1	--	1.31E+02	1.01E+01	20 MIN
FORGC	13	6.3E-09	10	2.9E-10	10	979.3	--	2.41E+02	7.35E+01	20 MIN
FORVC	13	6.3E-09	10	2.9E-10	10	915.1	--	2.25E+02	1.72E+01	20 MIN
FOSVF	13	N/A	--	2.9E-10	10	8151.1	--	--	2.04E+02	1 HR
F014 - Direct large aircraft crash damages the MDB; fire contained in 0.5 hours										
FOBGF	14	N/A	--	9.7E-14	13	2656.4	--	--	2.30E+02	30 MIN
FOKGF	14	N/A	--	9.7E-14	13	9016.4	--	--	7.60E+02	30 MIN
FOKHF	14	2.1E-12	13	9.7E-14	13	10219.1	--	--	4.30E+02	30 MIN
FOKVF	14	2.1E-12	13	9.7E-14	13	9615.1	--	--	2.03E+02	30 MIN
FOSVF	14	N/A	--	9.7E-14	13	8151.1	--	--	1.72E+02	30 MIN
F015 - Indirect large aircraft crash damages the MHI; no fire										
FOBGS	15	N/A	--	2.9E-12	13	7040.0	--	0.00E+00	6.30E+00	1 hr
FOBHC	15	6.3E-11	13	2.9E-12	13	4608.0	--	0.00E+00	NS	1 hr
FOCGC	15	6.3E-11	13	2.9E-12	13	614.4	--	0.00E+00	1.25E-01	1 hr
FOCHC	15	6.3E-11	13	2.9E-12	13	1228.8	--	0.00E+00	NS	1 hr
FOKGS	15	N/A	--	2.9E-12	13	24000.0	--	0.00E+00	6.30E+00	1 hr
FOKHS	15	6.3E-11	13	2.9E-12	13	27200.0	--	0.00E+00	NS	1 hr
FOKVS	15	6.3E-11	13	2.9E-12	13	25600.0	--	0.00E+00	NS	1 hr
FOMVC	15	6.3E-11	13	2.9E-12	13	6048.0	--	3.15E+01	NS	1 hr
FOFGC	15	6.3E-11	13	2.9E-12	13	832.0	--	0.00E+00	2.80E-01	1 hr

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
2.9E-10	10	246.8	--	5.76E+01	1.85E+01	20 MIN
2.9E-10	10	479.9	--	1.15E+02	1.80E+01	20 MIN
2.9E-10	10	9016.4	--	--	9.02E+02	1 HR
2.9E-10	10	10219.1	--	--	5.11E+02	1 HR
2.9E-10	10	9615.1	--	--	2.40E+02	1 HR
2.9E-10	10	2283.1	--	5.67E+02	4.28E+01	20 MIN
2.9E-10	10	328.4	--	7.80E+01	2.46E+01	20 MIN
2.9E-10	10	580.7	--	1.40E+02	2.18E+01	20 MIN
2.9E-10	10	303.1	--	7.20E+01	5.68E+00	20 MIN
2.9E-10	10	538.4	--	1.31E+02	4.04E+01	20 MIN
2.9E-10	10	537.1	--	1.31E+02	1.01E+01	20 MIN
2.9E-10	10	979.3	--	2.41E+02	7.35E+01	20 MIN
2.9E-10	10	915.1	--	2.25E+02	1.72E+01	20 MIN
2.9E-10	10	8151.1	--	--	2.04E+02	1 HR
9.7E-14	13	2656.4	--	--	2.30E+02	30 MIN
9.7E-14	13	9016.4	--	--	7.60E+02	30 MIN
9.7E-14	13	10219.1	--	--	4.30E+02	30 MIN
9.7E-14	13	9615.1	--	--	2.03E+02	30 MIN
9.7E-14	13	8151.1	--	--	1.72E+02	30 MIN
2.9E-12	13	7040.0	--	0.00E+00	6.30E+00	1 hr
2.9E-12	13	4608.0	--	0.00E+00	NS	1 hr
2.9E-12	13	614.4	--	0.00E+00	1.25E-01	1 hr
2.9E-12	13	1228.8	--	0.00E+00	NS	1 hr
2.9E-12	13	24000.0	--	0.00E+00	6.30E+00	1 hr
2.9E-12	13	27200.0	--	0.00E+00	NS	1 hr
2.9E-12	13	25600.0	--	0.00E+00	NS	1 hr
2.9E-12	13	6048.0	--	3.15E+01	NS	1 hr
2.9E-12	13	832.0	--	0.00E+00	2.80E-01	1 hr

File: FLTCOL.WK1, 20-Aug-87 PAGE4

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	AMAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
POPHC	15	6.3E-11	13	2.9E-12	13	1497.6	--	0.00E+00	NS	1 hr
FOPVC	15	6.3E-11	13	2.9E-12	13	768.0	--	0.00E+00	NS	1 hr
FODGC	15	6.3E-11	13	2.9E-12	13	1392.0	--	0.00E+00	4.53E-01	1 hr
FODVC	15	N/A	--	2.9E-12	13	1392.0	--	0.00E+00	NS	1 hr
FOFGC	15	6.3E-11	13	2.9E-12	13	2568.0	--	2.14E+01	5.65E-01	1 hr
FOGVC	15	6.3E-11	13	2.9E-12	13	2400.0	--	2.00E+01	NS	1 hr
FOSVS	15	N/A	--	2.9E-12	13	21696.0	--	0.00E+00	NS	1 hr
F016 - Indirect large aircraft crash damages the MHI; fire not contained in 0.5 hours										
FOBGF	16	N/A	--	2.3E-12	13	7040.0	--	--	7.04E+02	1 HR
PODHC	16	5.2E-11	13	2.4E-12	13	4608.0	--	1.15E+03	1.73E+02	20 MIN
FOCGC	16	5.2E-11	13	2.4E-12	13	614.4	--	1.54E+02	4.61E+01	20 MIN
FOCHC	16	5.2E-11	13	2.4E-12	13	1228.8	--	3.07E+02	4.61E+01	20 MIN
FORGF	16	N/A	--	2.3E-12	13	24000.0	--	--	2.40E+03	1 HR
FOKHF	16	5.1E-11	13	2.3E-12	13	27200.0	--	--	1.36E+03	1 HR
FOKVF	16	5.1E-11	13	2.3E-12	13	25600.0	--	--	6.40E+02	1 HR
FOMVC	16	5.2E-11	13	2.4E-12	13	6048.0	--	1.51E+03	1.13E+02	20 MIN
FOPGC	16	5.2E-11	13	2.4E-12	13	832.0	--	2.08E+02	6.24E+01	20 MIN
FOFHC	16	5.2E-11	13	2.4E-12	13	1497.6	--	3.74E+02	5.62E+01	20 MIN
FOFVC	16	5.2E-11	13	2.4E-12	13	768.0	--	1.92E+02	1.44E+01	20 MIN
FOOGC	16	5.2E-11	13	2.4E-12	13	1392.0	--	3.48E+02	1.04E+02	20 MIN
FOQVC	16	N/A	--	2.4E-12	13	1392.0	--	3.48E+02	2.61E+01	20 MIN
FORGC	16	5.2E-11	13	2.4E-12	13	2568.0	--	6.42E+02	1.93E+02	20 MIN
FORVC	16	5.2E-11	13	2.4E-12	13	2400.0	--	6.00E+02	4.50E+01	20 MIN
POSVF	16	N/A	--	2.3E-12	13	21696.0	--	--	5.42E+02	1 HR
F017 - Indirect large aircraft crash damages the MHI; fire contained in 0.5 hours										
FOBGF	17	N/A	--	8.0E-16	16	7040.0	--	--	2.20E+01	30 min
FORGF	17	N/A	--	8.0E-16	16	24000.0	--	--	1.50E+02	30 min
FOKHF	17	1.8E-14	16	8.0E-16	16	27200.0	--	--	8.50E+01	30 min
FOAVF	17	1.8E-14	16	8.0E-16	16	25600.0	--	--	4.00E+01	30 min
FOSVF	17	N/A	--	8.0E-16	16	21696.0	--	--	3.39E+01	30 min

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
2.9E-12	13	1497.6	--	0.00E+00	NS	1 hr
2.9E-12	13	768.0	--	0.00E+00	NS	1 hr
2.9E-12	13	1392.0	--	0.00E+00	4.53E-01	1 hr
2.9E-12	13	1392.0	--	0.00E+00	NS	1 hr
2.9E-12	13	2568.0	--	2.14E+01	5.65E-01	1 hr
2.9E-12	13	2400.0	--	2.00E+01	NS	1 hr
2.9E-12	13	21696.0	--	0.00E+00	NS	1 hr
2.3E-12	13	7040.0	--	--	7.04E+02	1 HR
2.4E-12	13	4608.0	--	1.15E+03	1.73E+02	20 MIN
2.4E-12	13	614.4	--	1.54E+02	4.61E+01	20 MIN
2.4E-12	13	1228.8	--	3.07E+02	4.61E+01	20 MIN
2.3E-12	13	24000.0	--	--	2.40E+03	1 HR
2.3E-12	13	27200.0	--	--	1.36E+03	1 HR
2.3E-12	13	25600.0	--	--	6.40E+02	1 HR
2.4E-12	13	6048.0	--	1.51E+03	1.13E+02	20 MIN
2.4E-12	13	832.0	--	2.08E+02	6.24E+01	20 MIN
2.4E-12	13	1497.6	--	3.74E+02	5.62E+01	20 MIN
2.4E-12	13	768.0	--	1.92E+02	1.44E+01	20 MIN
2.4E-12	13	1392.0	--	3.48E+02	1.04E+02	20 MIN
2.4E-12	13	1392.0	--	3.48E+02	2.61E+01	20 MIN
2.4E-12	13	2568.0	--	6.42E+02	1.93E+02	20 MIN
2.4E-12	13	2400.0	--	6.00E+02	4.50E+01	20 MIN
2.3E-12	13	21696.0	--	--	5.42E+02	1 HR
8.0E-16	16	7040.0	--	--	2.20E+01	30 min
8.0E-16	16	24000.0	--	--	1.50E+02	30 min
8.0E-16	16	27200.0	--	--	8.50E+01	30 min
8.0E-16	16	25600.0	--	--	4.00E+01	30 min
8.0E-16	16	21696.0	--	--	3.39E+01	30 min

File: PLTCOL.WK1, 20-Aug-87 PAGE5

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME	TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
F018 - Indirect large aircraft crash damages the MDB; no fire																	
FOBGS	18	N/A	--	4.0E-10	11	2640.0	--	--	6.10E+00	1 HR	4.0E-10	11	2640.0	--	--	6.10E+00	1 HR
FODHC	18	8.8E-09	11	4.0E-10	11	1728.0	--	--	NS	1 HR	4.0E-10	11	1728.0	--	--	NS	1 HR
FOCGC	18	8.8E-09	11	4.0E-10	11	230.4	--	--	1.04E-01	1 HR	4.0E-10	11	230.4	--	--	1.04E-01	1 HR
FOCHC	18	8.8E-09	11	4.0E-10	11	460.8	--	--	NS	1 HR	4.0E-10	11	460.8	--	--	NS	1 HR
FOKGS	18	N/A	--	4.0E-10	11	9000.0	--	--	6.80E+00	1 HR	4.0E-10	11	9000.0	--	--	6.80E+00	1 HR
FOKHS	18	8.8E-09	11	4.0E-10	11	10200.0	--	--	NS	1 HR	4.0E-10	11	10200.0	--	--	NS	1 HR
FOKVS	18	8.8E-09	11	4.0E-10	11	9600.0	--	--	NS	1 HR	4.0E-10	11	9600.0	--	--	NS	1 HR
FOMVC	18	8.8E-09	11	4.0E-10	11	2268.0	--	3.15E+01	NS	1 HR	4.0E-10	11	2268.0	--	3.15E+01	NS	1 HR
FOFGC	18	8.8E-09	11	4.0E-10	11	312.0	--	--	1.30E-01	1 HR	4.0E-10	11	312.0	--	--	1.30E-01	1 HR
FOFHC	18	8.8E-09	11	4.0E-10	11	561.6	--	--	NS	1 HR	4.0E-10	11	561.6	--	--	NS	1 HR
FOFVC	18	8.8E-09	11	4.0E-10	11	288.0	--	--	NS	1 HR	4.0E-10	11	288.0	--	--	NS	1 HR
FOQGC	18	8.8E-09	11	4.0E-10	11	522.0	--	--	1.99E-01	1 HR	4.0E-10	11	522.0	--	--	1.99E-01	1 HR
FOQVC	18	N/A	--	4.0E-10	11	522.0	--	--	NS	1 HR	4.0E-10	11	522.0	--	--	NS	1 HR
FORGC	18	8.8E-09	11	4.0E-10	11	963.0	--	2.14E+01	5.44E-01	1 HR	4.0E-10	11	963.0	--	2.14E+01	5.44E-01	1 HR
FORVC	18	8.8E-09	11	4.0E-10	11	900.0	--	2.00E+01	NS	1 HR	4.0E-10	11	900.0	--	2.00E+01	NS	1 HR
FOSVS	18	N/A	--	4.0E-10	11	8136.0	--	--	NS	1 HR	4.0E-10	11	8136.0	--	--	NS	1 HR
F019 - Indirect large aircraft crash damages the MDB; fire not contained in 0.5 hours																	
FOBGF	19	N/A	--	3.3E-10	11	2640.0	--	--	2.64E+02	1 HR	3.3E-10	11	2640.0	--	--	2.64E+02	1 HR
FODHC	19	7.2E-09	11	3.3E-10	11	1728.0	--	4.32E+02	6.48E+01	20 MIN	3.3E-10	11	1728.0	--	4.32E+02	6.48E+01	20 MIN
FOCGC	19	7.2E-09	11	3.3E-10	11	230.4	--	5.76E+01	1.73E+01	20 MIN	3.3E-10	11	230.4	--	5.76E+01	1.73E+01	20 MIN
FOCHC	19	7.2E-09	11	3.3E-10	11	460.8	--	1.15E+02	1.73E+01	20 MIN	3.3E-10	11	460.8	--	1.15E+02	1.73E+01	20 MIN
FOKGF	19	N/A	--	3.3E-10	11	9000.0	--	--	9.00E+02	1 HR	3.3E-10	11	9000.0	--	--	9.00E+02	1 HR
FOKHF	19	7.1E-09	11	3.3E-10	11	10200.0	--	--	5.10E+02	1 HR	3.3E-10	11	10200.0	--	--	5.10E+02	1 HR
FOKVF	19	7.1E-09	11	3.3E-10	11	9600.0	--	--	2.40E+02	1 HR	3.3E-10	11	9600.0	--	--	2.40E+02	1 HR
FOMVC	19	7.2E-09	11	3.3E-10	11	2268.0	--	5.67E+02	4.25E+01	20 MIN	3.3E-10	11	2268.0	--	5.67E+02	4.25E+01	20 MIN
FOFGC	19	7.2E-09	11	3.3E-10	11	312.0	--	7.80E+01	2.34E+01	20 MIN	3.3E-10	11	312.0	--	7.80E+01	2.34E+01	20 MIN
FOFHC	19	7.2E-09	11	3.3E-10	11	561.6	--	1.40E+02	2.11E+01	20 MIN	3.3E-10	11	561.6	--	1.40E+02	2.11E+01	20 MIN
FOFVC	19	7.2E-09	11	3.3E-10	11	288.0	--	7.20E+01	5.40E+00	20 MIN	3.3E-10	11	288.0	--	7.20E+01	5.40E+00	20 MIN
FOQGC	19	7.2E-09	11	3.3E-10	11	522.0	--	1.31E+02	3.92E+01	20 MIN	3.3E-10	11	522.0	--	1.31E+02	3.92E+01	20 MIN

File: PLTCOL.WK1, 20-Aug-87 PAGE6

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
FOQVC	19	N/A	--	3.3E-10	11	522.0	--	1.31E+02	9.79E+00	20 MIN
FORGC	19	7.2E-09	11	3.3E-10	11	963.0	--	2.41E+02	7.22E+01	20 MIN
FORVC	19	7.2E-09	11	3.3E-10	11	900.0	--	2.25E+02	1.69E+01	20 MIN
FOSVF	19	N/A	--	3.3E-10	11	8136.0	--	--	2.03E+02	1 HR
F020 - Indirect large aircraft crash damages the MDB; fire contained in 0.5 hours										
FOBGF	20	N/A	--	1.1E-13	14	2640.0	--	--	9.70E+00	30 MIN
FOHGF	20	N/A	--	1.1E-13	14	9000.0	--	--	9.60E+00	30 MIN
FOHHF	20	2.4E-12	14	1.1E-13	14	10200.0	--	--	2.70E+00	30 MIN
FORVF	20	2.4E-12	14	1.1E-13	14	9600.0	--	--	7.00E-01	30 MIN
FOSVF	20	N/A	--	1.1E-13	14	8136.0	--	--	7.00E-01	30 MIN
F021 - Large or small aircraft crash damages the outdoor agent piping system at TEAD; no fire										
FOAGS	21	N/A	--	1.0E-08	10	548.0	5.48E+02	--	--	1 HR
FOAHS	21	N/A	--	1.0E-08	10	638.0	6.38E+02	--	--	1 HR
FOAVS	21	N/A	--	1.0E-08	10	507.0	5.07E+02	--	--	1 HR
F022 - Large or small aircraft crash damages the outdoor agent piping system at TEAD; fire occurs										
FOAGS	22	N/A	--	8.2E-09	10	548.0	--	--	5.48E+01	10 MIN
FOAHS	22	N/A	--	8.2E-09	10	638.0	--	--	3.19E+01	10 MIN
FOAVS	22	N/A	--	8.2E-09	10	507.0	--	--	1.27E+01	10 MIN

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
3.3E-10	11	522.0	--	1.31E+02	9.79E+00	20 MIN
3.3E-10	11	963.0	--	2.41E+02	7.22E+01	20 MIN
3.3E-10	11	900.0	--	2.25E+02	1.69E+01	20 MIN
3.3E-10	11	8136.0	--	--	2.03E+02	1 HR
1.1E-13	14	2640.0	--	--	9.70E+00	30 MIN
1.1E-13	14	9000.0	--	--	9.60E+00	30 MIN
1.1E-13	14	10200.0	--	--	2.70E+00	30 MIN
1.1E-13	14	9600.0	--	--	7.00E-01	30 MIN
1.1E-13	14	8136.0	--	--	7.00E-01	30 MIN
1.0E-08	10	548.0	5.48E+02	--	--	1 HR
1.0E-08	10	638.0	6.38E+02	--	--	1 HR
1.0E-08	10	507.0	5.07E+02	--	--	1 HR
8.2E-09	10	548.0	--	--	5.48E+01	10 MIN
8.2E-09	10	638.0	--	--	3.19E+01	10 MIN
8.2E-09	10	507.0	--	--	1.27E+01	10 MIN

Notes:

1. Frequency unit = events/operating year
2. Scenarios 21 and 22 apply only to the TEAD bulk-only facility

File: FLTCOL.WK1, 20-Aug-87 PAGE1

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
FO25 - Earthquake damages the MDB structure, munitions fall & puncture; fire suppressed										
F0BGC	25	N/A	--	1.9E-07	7	2640.0	--	--	2.20E+01	6 HR
F0BHC	25	NEGL	--	NEGL	--	1728.0	--	--	3.00E-01	6 HR
F0CGC	25	NEGL	--	NEGL	--	230.4	--	--	2.00E-01	6 HR
F0CHC	25	NEGL	--	NEGL	--	460.8	--	--	1.60E-01	6 HR
F0FGC	25	N/A	--	1.6E-06	7	9000.0	--	--	1.50E+02	6 HR
F0FHC	25	7.1E-08	7	1.6E-06	7	10200.0	--	--	8.50E+01	6 HR
F0FVC	25	7.1E-08	7	1.6E-06	7	9600.0	--	--	4.00E+01	6 HR
F0MVC	25	2.3E-09	6	5.0E-08	7	2268.0	--	--	2.60E-01	6 HR
F0PGC	25	NEGL	--	NEGL	--	312.0	--	--	6.50E-01	6 HR
F0PHC	25	NEGL	--	NEGL	--	561.6	--	--	5.90E-01	6 HR
F0PVC	25	NEGL	--	NEGL	--	288.0	--	--	1.50E-01	6 HR
F0QGC	25	NEGL	--	NEGL	--	522.0	--	--	2.70E-01	6 HR
F0QVC	25	N/A	--	NEGL	--	522.0	--	--	3.60E-01	6 HR
F0RGC	25	1.5E-08	6	3.3E-07	7	963.0	--	--	1.10E+00	6 HR
F0RVC	25	1.5E-08	6	3.3E-07	7	900.0	--	--	2.50E-01	6 HR
F0SVC	25	3.9E-07	7	8.4E-06	7	8136.0	--	--	3.40E+01	6 HR
FO26 - Earthquake damages the MDB structure, munitions fall & puncture; earthquake initiates fire; fire suppression system fails.										
F0BGC	26	N/A	--	6.1E-09	13	2640.0	--	--	2.64E+02	6 HR
F0BHC	26	NEGL	--	NEGL	--	1728.0	--	4.32E+02	6.48E+01	6 HR
F0CGC	26	NEGL	--	NEGL	--	230.4	--	5.76E+01	1.73E+01	6 HR
F0CHC	26	NEGL	--	NEGL	--	460.8	--	1.15E+02	1.73E+01	6 HR
F0FGC	26	N/A	--	4.9E-08	13	9000.0	--	--	9.00E+02	6 HR
F0FHC	26	1.8E-09	11	4.9E-08	13	10200.0	--	--	5.10E+02	6 HR
F0FVC	26	1.8E-09	11	4.9E-09	13	9600.0	--	--	2.40E+02	6 HR
F0MVC	26	NEGL	--	NEGL	--	2268.0	--	5.67E+02	4.25E+01	6 HR
F0PGC	26	NEGL	--	NEGL	--	312.0	--	7.80E+01	2.34E+01	6 HR
F0PHC	26	NEGL	--	NEGL	--	561.6	--	1.40E+02	2.11E+01	6 HR
F0PVC	26	NEGL	--	NEGL	--	288.0	--	7.20E+01	5.40E+00	6 HR
F0QGC	26	NEGL	--	NEGL	--	522.0	--	1.31E+02	3.92E+01	6 HR

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
1.9E-07	7	2640.0	--	--	2.20E+01	6 HR
NEGL	--	1728.0	--	--	3.00E-01	6 HR
NEGL	--	230.4	--	--	2.00E-01	6 HR
NEGL	--	460.8	--	--	1.60E-01	6 HR
1.6E-06	7	9000.0	--	--	1.50E+02	6 HR
1.6E-06	7	10200.0	--	--	8.50E+01	6 HR
1.6E-06	7	9600.0	--	--	4.00E+01	6 HR
5.0E-08	7	2268.0	--	--	2.60E-01	6 HR
NEGL	--	312.0	--	--	6.50E-01	6 HR
NEGL	--	561.6	--	--	5.90E-01	6 HR
NEGL	--	288.0	--	--	1.50E-01	6 HR
NEGL	--	522.0	--	--	2.70E-01	6 HR
NEGL	--	522.0	--	--	3.60E-01	6 HR
3.3E-07	7	963.0	--	--	1.10E+00	6 HR
3.3E-07	7	900.0	--	--	2.50E-01	6 HR
8.4E-06	7	8136.0	--	--	3.40E+01	6 HR
6.1E-09	13	2640.0	--	--	2.64E+02	6 HR
NEGL	--	1728.0	--	4.32E+02	6.48E+01	6 HR
NEGL	--	230.4	--	5.76E+01	1.73E+01	6 HR
NEGL	--	460.8	--	1.15E+02	1.73E+01	6 HR
4.9E-08	13	9000.0	--	--	9.00E+02	6 HR
4.9E-08	13	10200.0	--	--	5.10E+02	6 HR
4.9E-08	13	9600.0	--	--	2.40E+02	6 HR
NEGL	--	2268.0	--	5.67E+02	4.25E+01	6 HR
NEGL	-	312.0	--	7.80E+01	2.34E+01	6 HR
NEGL	--	561.6	--	1.40E+02	2.11E+01	6 HR
NEGL	--	289.0	--	7.20E+01	5.40E+00	6 HR
NEGL	--	522.0	--	1.31E+02	3.92E+01	6 HR

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME	TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
F0QVC	26	N/A	--	NEGL	--	522.0	--	1.31E+02	9.79E+00	6 HR	NEGL	--	522.0	--	1.31E+02	9.79E+00	6 HR
F0RGC	26	4.0E-10	11	1.0E-08	14	963.0	--	2.41E+02	7.22E+01	6 HR	1.0E-08	14	963.0	--	2.41E+02	7.22E+01	6 HR
F0RVC	26	4.0E-10	11	1.0E-08	14	900.0	--	2.25E+02	1.69E+01	6 HR	1.0E-08	14	900.0	--	2.25E+02	1.69E+01	6 HR
F0SVC	26	N/A	--	2.7E-07	13	8136.0	--	--	2.03E+02	6 HR	2.7E-07	13	8136.0	--	--	2.03E+02	6 HR
F029 - Earthquake damages the MDB; munitions are intact; fire occurs; fire suppression system fails.																	
F0BGC	29	N/A	--	2.2E-05	10	2640.0	--	--	2.64E+02	6 HR	2.2E-05	10	2640.0	--	--	2.64E+02	6 HR
F0DHC	29	7.8E-07	9	2.2E-05	10	1728.0	--	4.32E+02	6.48E+01	6 HR	2.2E-05	10	1728.0	--	4.32E+02	6.48E+01	6 HR
F0CGC	29	7.8E-07	9	2.2E-05	10	230.4	--	5.76E+01	1.73E+01	6 HR	2.2E-05	10	230.4	--	5.76E+01	1.73E+01	6 HR
F0CHC	29	7.8E-07	9	2.2E-05	10	460.8	--	1.15E+02	1.73E+01	6 HR	2.2E-05	10	460.8	--	1.15E+02	1.73E+01	6 HR
F0FGC	29	N/A	--	2.2E-05	10	9000.0	--	--	9.00E+02	6 HR	2.2E-05	10	9000.0	--	--	9.00E+02	6 HR
F0FHC	29	7.8E-07	9	2.2E-05	10	10200.0	--	--	5.10E+02	6 HR	2.2E-05	10	10200.0	--	--	5.10E+02	6 HR
F0FVC	29	7.8E-07	9	2.2E-05	10	9600.0	--	--	2.40E+02	6 HR	2.2E-05	10	9600.0	--	--	2.40E+02	6 HR
F0MVC	29	7.8E-07	9	2.2E-05	10	2268.0	--	5.67E+02	4.25E+01	6 HR	2.2E-05	10	2268.0	--	5.67E+02	4.25E+01	6 HR
F0PGC	29	7.8E-07	9	2.2E-05	10	312.0	--	7.80E+01	2.34E+01	6 HR	2.2E-05	10	312.0	--	7.80E+01	2.34E+01	6 HR
F0PHC	29	7.8E-07	9	2.2E-05	10	561.6	--	1.40E+02	2.11E+01	6 HR	2.2E-05	10	561.6	--	1.40E+02	2.11E+01	6 HR
F0PVC	29	7.8E-07	9	2.2E-05	10	288.0	--	7.20E+01	5.40E+00	6 HR	2.2E-05	10	288.0	--	7.20E+01	5.40E+00	6 HR
F0QGC	29	7.6E-07	9	2.2E-05	10	522.0	--	1.31E+02	3.92E+01	6 HR	2.2E-05	10	522.0	--	1.31E+02	3.92E+01	6 HR
F0QVC	29	N/A	--	2.2E-05	10	522.0	--	1.31E+02	9.79E+00	6 HR	2.2E-05	10	522.0	--	1.31E+02	9.79E+00	6 HR
F0RGC	29	7.8E-07	9	2.2E-05	10	963.0	--	2.41E+02	7.22E+01	6 HR	2.2E-05	10	963.0	--	2.41E+02	7.22E+01	6 HR
F0RVC	29	7.8E-07	9	2.2E-05	10	900.0	--	2.25E+02	1.69E+01	6 HR	2.2E-05	10	900.0	--	2.25E+02	1.69E+01	6 HR
F0SVC	29	N/A	--	2.2E-05	10	8136.0	--	--	2.03E+02	6 HR	2.2E-05	10	8136.0	--	--	2.03E+02	6 HR
F033 - Earthquake causes munitions to fall but no detonation occurs; the MDB is intact; the TOX is intact; earthquake initiates fire; fire suppression system fails.																	
F0BGC	33	N/A	--	N/A	--	2640.0	--	--	2.64E+02	6 HR	N/A	--	2640.0	--	--	2.64E+02	6 HR
F0DHC	33	1.7E-06	20	4.8E-05	20	1728.0	--	4.32E+02	6.48E+01	6 HR	4.8E-05	20	1728.0	--	4.32E+02	6.48E+01	6 HR
F0CGC	33	1.7E-06	20	4.8E-05	20	230.4	--	5.76E+01	1.73E+01	6 HR	4.8E-05	20	230.4	--	5.76E+01	1.73E+01	6 HR
F0CHC	33	1.7E-06	20	4.8E-05	20	460.8	--	1.15E+02	1.73E+01	6 HR	4.8E-05	20	460.8	--	1.15E+02	1.73E+01	6 HR
F0FGC	33	N/A	--	N/A	--	9000.0	--	--	9.00E+02	6 HR	N/A	--	9000.0	--	--	9.00E+02	6 HR
F0FHC	33	N/A	--	N/A	--	10200.0	--	--	5.10E+02	6 HR	N/A	--	10200.0	--	--	5.10E+02	6 HR
F0FVC	33	N/A	--	N/A	--	9600.0	--	--	2.40E+02	6 HR	N/A	--	9600.0	--	--	2.40E+02	6 HR
F0MVC	33	1.7E-06	20	4.8E-05	20	2268.0	--	5.67E+02	4.25E+01	6 HR	4.8E-05	20	2268.0	--	5.67E+02	4.25E+01	6 HR

File: PLTCOL.WK1, 20-Aug-87 PAGE3

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

SCENARIO I.D.	NO.	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TOTAL AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
FOFGC	33	1.7E-06	20	4.8E-05	20	312.0	--	7.80E+01	2.34E+01	6 HR
FOFHC	33	1.7E-06	20	4.8E-05	20	561.6	--	1.40E+02	2.11E+01	6 HR
FOFVC	33	1.7E-06	20	4.8E-05	20	288.0	--	7.20E+01	5.40E+00	6 HR
FOBGC	33	1.7E-06	20	4.8E-05	20	522.0	--	1.31E+02	3.92E+01	6 HR
FOBVC	33	N/A	--	4.8E-05	20	522.0	--	1.31E+02	9.79E+00	6 HR
FORGC	33	1.7E-06	20	4.8E-05	20	963.0	--	2.41E+02	7.22E+01	6 HR
FORVC	33	1.7E-06	20	4.8E-05	20	900.0	--	2.25E+02	1.69E+01	6 HR
FOSVC	33	N/A	--	N/A	--	8136.0	--	--	2.03E+02	6 HR

PLANT OPERATIONS COLLOCATION
MEDIAN ACCIDENT FREQUENCY (PER YEAR)

TEAD NDC FREQ	RANGE FACTOR	TOTAL AVAILAB	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
4.8E-05	20	312.0	--	7.80E+01	2.34E+01	6 HR
4.8E-05	20	561.6	--	1.40E+02	2.11E+01	6 HR
4.8E-05	20	288.0	--	7.20E+01	5.40E+00	6 HR
4.8E-05	20	522.0	--	1.31E+02	3.92E+01	6 HR
4.8E-05	20	522.0	--	1.31E+02	9.79E+00	6 HR
4.8E-05	20	963.0	--	2.41E+02	7.22E+01	6 HR
4.8E-05	20	900.0	--	2.25E+02	1.69E+01	6 HR
N/A	--	8136.0	--	--	2.03E+02	6 HR

Notes:

1. Frequency unit = events/operating year

DATE21-Aug-87 PAGE1 PLTOPSOS

PLANT OPERATIONS INTERNAL INITIATING EVENTS
RDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

PLANT OPERATIONS INTERNAL INITIATING EVENTS
NDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

	SCENA NUMBE	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR	TEAD NDC FREQ	RANGE FACTOR	AGENT AVAIL	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
POAGC	41	3.3E-10	4.8E+01	3.3E-10	4.8E+01	3.3E-10	4.8E+01	262.5	--	--	1.01E+02	15 MIN
POAHC	41	3.3E-10	4.8E+01	3.3E-10	4.8E+01	3.3E-10	4.8E+01	262.5	--	--	1.01E+02	15 MIN
POAVC	41	3.3E-10	4.8E+01	3.3E-10	4.8E+01	3.3E-10	4.8E+01	175.5	--	--	1.80E+00	15 MIN
POBGC	42	N/A	--	9.9E-09	3.7E+01	9.9E-09	3.7E+01	11.0	--	--	2.20E+01	12 MIN
PODHC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01	21.6	--	--	2.16E+01	12 MIN
POCGC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01	5.8	--	--	5.80E+00	12 MIN
POCHC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01	11.5	--	--	1.15E+01	12 MIN
POKGC	42	N/A	--	9.9E-09	3.7E+01	9.9E-09	3.7E+01	75.0	--	--	3.75E+01	12 MIN
POKHC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01	85.0	--	--	4.25E+01	12 MIN
POKVC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01	80.0	--	--	4.00E+01	12 MIN
POMVC	42	N/A	--	N/A	--	N/A	--	--	--	--	--	--
POPGC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01	15.6	--	--	1.56E+01	12 MIN
POPHC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01	28.1	--	--	2.81E+01	12 MIN
POPVC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01	14.4	--	--	1.44E+01	12 MIN
POQGC	42	9.9E-09	3.7E+01	9.9E-09	3.7E+01	9.9E-09	3.7E+01	19.6	--	--	1.96E+01	12 MIN
POQVC	42	N/A	--	9.9E-09	3.7E+01	9.9E-09	3.7E+01	19.6	--	--	1.96E+01	12 MIN
PORGC	42	N/A	--	N/A	--	N/A	--	--	--	--	--	--
PORVC	42	N/A	--	N/A	--	N/A	--	--	--	--	--	--
POSVC	42	N/A	--	9.9E-09	3.7E+01	9.9E-09	3.7E+01	67.8	--	--	3.39E+01	12 MIN
FOBGC	43	N/A	--	1.6E-09	4.1E+01	1.6E-09	4.1E+01	220.0	--	--	NEGL	--
POYGC	43	N/A	--	2.3E-10	4.1E+01	2.3E-10	4.1E+01	1500.0	--	--	NEGL	--
FOKHC	43	2.7E-10	4.1E+01	2.7E-10	4.1E+01	2.7E-10	4.1E+01	1700.0	--	--	NEGL	--
POKVC	43	1.5E-10	4.1E+01	1.5E-10	4.1E+01	1.5E-10	4.1E+01	1600.0	--	--	NEGL	--
POSVC	43	N/A	--	1.8E-10	4.1E+01	1.8E-10	4.1E+01	1356.0	--	--	NEGL	--
FOBGC	44	N/A	--	1.6E-10	4.1E+01	1.6E-10	4.1E+01	220.0	--	--	2.20E+02	2 MIN
FOKGC	44	N/A	--	2.3E-10	4.1E+01	2.3E-10	4.1E+01	1500.0	--	--	1.50E+03	2 MIN
POKHC	44	2.7E-10	4.1E+01	2.7E-10	4.1E+01	2.7E-10	4.1E+01	1700.0	--	--	1.70E+03	2 MIN
FOKVC	44	1.5E-10	4.1E+01	1.5E-10	4.1E+01	1.5E-10	4.1E+01	1600.0	--	--	1.60E+03	2 MIN
FOSVC	44	N/A	--	1.8E-10	4.1E+01	1.8E-10	4.1E+01	1356.0	--	--	1.36E+03	2 MIN

DATE21-Aug-87 PAGE2 PLTOPSOS

PLANT OPERATIONS INTERNAL INITIATING EVENTS
RDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

	SCENA NUMBE	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR
POKGF	45	N/A	--	4.0E-09	1.4E+01
POKNF	45	4.0E-10	1.4E+01	4.0E-10	1.4E+01
POKVF	45	4.0E-10	1.4E+01	4.0E-10	1.4E+01
PODHC	46	9.0E-09	2.6E+01	9.0E-09	2.6E+01
POCGC	46	1.0E-08	2.6E+01	1.0E-08	2.6E+01
POCHC	46	1.0E-08	2.6E+01	1.0E-08	2.6E+01
POMVC	46	4.0E-07	2.6E+01	4.0E-07	2.6E+01
POPGC	46	6.0E-07	2.6E+01	6.0E-07	2.6E+01
POPHC	46	6.0E-07	2.6E+01	6.0E-07	2.6E+01
POPVC	46	6.0E-07	2.6E+01	6.0E-07	2.6E+01
POQGC	46	3.0E-07	2.6E+01	3.0E-07	2.6E+01
POQVC	46	N/A	--	3.0E-07	2.6E+01
PORGC	46	1.5E-07	2.7E+01	1.5E-07	2.7E+01
PORVC	46	1.5E-07	2.7E+01	1.5E-07	2.7E+01
PODHC	47	8.1E-11	3.1E+01	8.1E-11	3.1E+01
POCGC	47	9.0E-11	3.1E+01	9.0E-11	3.1E+01
POCHC	47	9.0E-11	3.1E+01	9.0E-11	3.1E+01
POMVC	47	3.6E-09	3.1E+01	3.6E-09	3.1E+01
POPGC	47	5.4E-09	3.1E+01	5.4E-09	3.1E+01
POPHC	47	5.4E-09	3.1E+01	5.4E-09	3.1E+01
POPVC	47	5.4E-09	3.1E+01	5.4E-09	3.1E+01
POQGC	47	2.7E-09	3.1E+01	2.7E-09	3.1E+01
POQVC	47	N/A	--	2.7E-09	3.1E+01
PORGC	47	1.5E-07	2.7E+01	1.5E-07	2.7E+01
PORVC	47	1.5E-07	2.7E+01	1.5E-07	2.7E+01
PODHC	48	9.0E-12	3.3E+01	9.0E-12	3.3E+01
POCGC	48	1.0E-11	3.3E+01	1.0E-11	3.3E+01
POCHC	48	1.0E-11	3.3E+01	1.0E-11	3.3E+01
POMVC	48	4.0E-10	3.3E+01	4.0E-10	3.3E+01

PLANT OPERATIONS INTERNAL INITIATING EVENTS
NDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

TEAD NDC FREQ	RANGE FACTOR	AGENT AVAIL	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
4.0E-09	1.4E+01	1500.0	--	--	5.03E+01	106 MIN
4.0E-10	1.4E+01	1700.0	--	--	2.97E+01	114 MIN
4.0E-10	1.4E+01	1600.0	--	--	1.91E+01	80 MIN
9.0E-09	2.6E+01	6.0	--	NEGL	NEGL	--
1.0E-08	2.6E+01	1.6	--	1.00E-01	1.00E-01	60 MIN
1.0E-08	2.6E+01	3.2	--	1.00E-01	3.00E-03	60 MIN
4.0E-07	2.6E+01	10.5	--	NEGL	NEGL	--
6.0E-07	2.6E+01	6.5	--	6.00E-01	3.00E-01	60 MIN
6.0E-07	2.6E+01	11.7	--	1.00E+00	8.00E-03	60 MIN
6.0E-07	2.6E+01	6.0	--	5.00E-01	NEGL	60 MIN
3.0E-07	2.6E+01	14.5	--	2.60E+00	2.90E+00	60 MIN
3.0E-07	2.6E+01	14.5	--	2.60E+00	NEGL	60 MIN
1.5E-07	2.7E+01	10.7	--	1.00E+00	5.00E-01	60 MIN
1.5E-07	2.7E+01	10.0	--	9.00E-01	NEGL	60 MIN
8.1E-11	3.1E+01	6.0	--	NEGL	NEGL	--
9.0E-11	3.1E+01	1.6	--	1.00E-01	1.50E-01	20 MIN
9.0E-11	3.1E+01	3.2	--	1.00E-01	1.50E-01	20 MIN
3.6E-09	3.1E+01	10.5	--	NEGL	NEGL	--
5.4E-09	3.1E+01	6.5	--	6.00E-01	6.00E-01	20 MIN
5.4E-09	3.1E+01	11.7	--	1.00E+00	5.00E-01	20 MIN
5.4E-09	3.1E+01	6.0	--	5.00E-01	1.40E-01	20 MIN
2.7E-09	3.1E+01	14.5	--	2.60E+00	1.20E+00	20 MIN
2.7E-09	3.1E+01	14.5	--	2.60E+00	3.00E-01	20 MIN
1.5E-07	2.7E+01	10.7	--	1.00E+00	1.00E+00	20 MIN
1.5E-07	2.7E+01	10.0	--	9.00E-01	2.00E-01	20 MIN
9.0E-12	3.3E+01	1728.0	--	2.16E+02	3.20E+01	20 MIN
1.0E-11	3.3E+01	230.4	--	5.80E+01	1.72E+01	20 MIN
1.0E-11	3.3E+01	460.8	--	1.15E+02	1.72E+01	20 MIN
4.0E-10	3.3E+01	2268.0	--	5.67E+02	4.30E+01	20 MIN

DATE21-Aug-87 PAGE3 PLTOPSOS

PLANT OPERATIONS INTERNAL INITIATING EVENTS
RDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

	SCENA NUMBE	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR
POPGC	48	6.0E-10	3.3E+01	6.0E-10	3.3E+01
POPHC	48	6.0E-10	3.3E+01	6.0E-10	3.3E+01
POPVC	48	6.0E-10	3.3E+01	6.0E-10	3.3E+01
POQGC	48	3.0E-10	3.3E+01	3.0E-10	3.3E+01
POQVC	48	N/A	--	3.0E-10	3.3E+01
PORGC	48	1.5E-09	3.2E+01	1.5E-09	3.2E+01
PORVC	48	1.5E-09	3.2E+01	1.5E-09	3.2E+01
PODHC	49	3.0E-06	3.1E+01	3.0E-06	3.1E+01
POCGC	49	4.0E-06	3.1E+01	4.0E-06	3.1E+01
POCHC	49	4.0E-06	3.1E+01	4.0E-06	3.1E+01
POMVC	49	4.0E-09	3.7E+01	4.0E-09	3.7E+01
POPGC	49	2.0E-06	3.1E+01	2.0E-06	3.1E+01
POPHC	49	2.0E-06	3.1E+01	2.0E-06	3.1E+01
POPVC	49	2.0E-06	3.1E+01	2.0E-06	3.1E+01
POQGC	49	8.0E-07	3.1E+01	8.0E-07	3.1E+01
POQVC	49	N/A	--	8.0E-07	3.1E+01
PORGC	49	5.0E-07	3.4E+01	5.0E-07	3.4E+01
PORVC	49	5.0E-07	3.4E+01	5.0E-07	3.4E+01
PODHC	50	3.0E-08	3.7E+01	3.0E-08	3.7E+01
POCGC	50	4.0E-08	3.7E+01	4.0E-08	3.7E+01
POCHC	50	4.0E-08	3.7E+01	4.0E-08	3.7E+01
POMVC	50	4.0E-11	3.7E+01	4.0E-11	3.7E+01
POPGC	50	2.0E-08	3.7E+01	2.0E-08	3.7E+01
POPHC	50	2.0E-08	3.7E+01	2.0E-08	3.7E+01
POPVC	50	2.0E-08	3.7E+01	2.0E-08	3.7E+01
POQGC	50	8.0E-09	3.7E+01	8.0E-09	3.7E+01
POQVC	50	N/A	--	8.0E-09	3.7E+01
PORGC	50	5.0E-07	3.4E+01	5.0E-07	3.4E+01
PORVC	50	5.0E-07	3.4E+01	5.0E-07	3.4E+01

PLANT OPERATIONS INTERNAL INITIATING EVENTS
NDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

TEAD NDC FREQ	RANGE FACTOR	AGENT AVAIL	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
6.0E-10	3.3E+01	312.0	--	7.90E+01	2.36E+01	20 MIN
6.0E-10	3.3E+01	561.6	--	1.42E+02	2.15E+01	20 MIN
6.0E-10	3.3E+01	288.0	--	7.25E[illegible]	5.10E+00	20 MIN
3.0E-10	3.3E+01	522.0	--	1.34E+02	4.02E+01	20 MIN
3.0E-10	3.3E+01	522.0	--	1.34E+02	1.03E+01	20 MIN
1.5E-09	3.2E+01	963.0	--	2.42E+02	7.30E+01	20 MIN
1.5E-09	3.2E+01	900.0	--	2.26E+02	1.72E+01	20 MIN
3.0E-06	3.1E+01	6.0	--	6.00E+00	--	INSTANT
4.0E-06	3.1E+01	1.6	--	1.60E+00	--	INSTANT
4.0E-06	3.1E+01	3.2	--	3.20E+00	--	INSTANT
4.0E-09	3.7E+01	10.5	--	1.05E+01	--	INSTANT
2.0E-06	3.1E+01	6.5	--	6.50E+00	--	INSTANT
2.0E-06	3.1E+01	11.7	--	1.17E+01	--	INSTANT
2.0E-06	3.1E+01	6.0	--	6.00E+00	--	INSTANT
8.0E-07	3.1E+01	14.5	--	1.45E+01	--	INSTANT
8.0E-07	3.1E+01	14.5	--	1.45E+01	--	INSTANT
5.0E-07	3.4E+01	10.7	--	1.07E+01	--	INSTANT
5.0E-07	3.4E+01	10.0	--	1.00E+01	--	INSTANT
3.0E-08	3.7E+01	6.0	--	6.00E+00	--	INSTANT
4.0E-08	3.7E+01	1.6	--	1.60E+00	--	INSTANT
4.0E-08	3.7E+01	3.2	--	3.20E+00	--	INSTANT
4.0E-11	3.7E+01	10.5	--	1.05E+01	--	INSTANT
2.0E-08	3.7E+01	6.5	--	6.50E+00	--	INSTANT
2.0E-08	3.7E+01	11.7	--	1.17E+01	--	INSTANT
2.0E-08	3.7E+01	6.0	--	6.00E+00	--	INSTANT
8.0E-09	3.7E+01	14.5	--	1.45E+01	--	INSTANT
8.0E-09	3.7E+01	14.5	--	1.45E+01	--	INSTANT
5.0E-07	3.4E+01	10.7	--	1.07E+01	--	INSTANT
5.0E-07	3.4E+01	10.0	--	1.00E+01	--	INSTANT

PLANT OPERATIONS INTERNAL INITIATING EVENTS
RDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

	SCENA NUMBE	ANAD RDC FREQ	RANGE FACTOR	TEAD RDC FREQ	RANGE FACTOR
POKGF	51	N/A	--	4.0E-09	1.4E+01
POKHF	51	4.0E-09	1.4E+01	4.0E-09	1.4E+01
POKVF	51	4.0E-09	1.4E+01	4.0E-09	1.4E+01
PODHC	52	4.4E-03	5.7E+01	4.4E-03	5.7E+01
POCGC	52	5.0E-03	5.7E+01	5.0E-03	5.7E+01
POCHC	52	5.0E-03	5.7E+01	5.0E-03	5.7E+01
POMVC	52	1.1E-02	5.7E+01	1.1E-02	5.7E+01
POPGC	52	NEGL	--	NEGL	--
POPHC	52	NEGL	--	NEGL	--
POPVC	52	NEGL	--	NEGL	--
POQGC	52	NEGL	--	NEGL	--
POQVC	52	N/A	--	NEGL	--
PORGC	52	1.6E-03	5.7E+01	1.6E-03	5.7E+01
PORVC	52	1.6E-03	5.7E+01	1.6E-03	5.7E+01

PLANT OPERATIONS INTERNAL INITIATING EVENTS
NDC OPTION MEDIAN ACCIDENT FREQUENCY (PER FACILITY-YEAR)

TEAD NDC FREQ	RANGE FACTOR	AGENT AVAIL	LBS SPILLED	LBS DETONATED	LBS EMITTED	DURATION TIME
4.0E-09	1.4E+01	1500.0	--	--	2.90E+01	61.4 MIN
4.0E-09	1.4E+01	1700.0	--	--	1.80E+01	69.3 MIN
4.0E-09	1.4E+01	1600.0	--	--	5.80E+00	34.7 MIN
4.4E-03	5.7E+01	6.0	--	6.00E+00	--	INSTANT
5.0E-03	5.7E+01	1.6	--	1.60E+00	--	INSTANT
5.0E-03	5.7E+01	3.2	--	3.20E+00	--	INSTANT
1.1E-02	5.7E+01	10.5	--	1.05E+01	--	INSTANT
NEGL	--	6.5	--	6.50E+00	--	INSTANT
NEGL	--	11.7	--	1.17E+01	--	INSTANT
NEGL	--	6.0	--	6.00E+00	--	INSTANT
NEGL	--	14.5	--	1.45E+01	--	INSTANT
NEGL	--	14.5	--	1.45E+01	--	INSTANT
1.6E-03	5.7E+01	10.7	--	1.07E+01	--	INSTANT
1.6E-03	5.7E+01	10.0	--	1.00E+01	--	INSTANT

I.1.5. ONSITE TRANSPORT

The following tables list the accident results for onsite transport of munitions.

File: ONSITRES.WK1 Page 1 Date 19-Aug-87

ONSITE TRANSPORTATION - ONSITE PACKAGE - COLLOCATION OPTION
(MOVEMENT FROM STORAGE TO DEMIL FACILITY IN ONSITE PACKAGE)

Scenario Frequencies and Range Factors

Agent Available and Released

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VOBGS	1	N/A		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	1760.0	2.2E+02	--	--	2 HRS
VODHS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	1152.0	6.0E+00	--	--	2 HRS
VOCGS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	153.6	1.6E+00	--	--	2 HRS
VOCHS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	307.2	3.2E+00	--	--	2 HRS
VOKGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	6000.0	1.5E+03	--	--	2 HRS
VOKHS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	6800.0	1.7E+03	--	--	2 HRS
VOKVS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	6400.0	1.6E+03	--	--	2 HRS
VOMVS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	1512.0	1.0E+01	--	--	2 HRS
VOPGS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	208.0	6.5E+00	--	--	2 HRS
VOPHS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	374.4	1.2E+01	--	--	2 HRS
VOPVS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	192.0	6.0E+00	--	--	2 HRS
VOQGS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	348.0	1.5E+01	--	--	2 HRS
VOQVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	348.0	1.5E+01	--	--	2 HRS
VORGS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	642.0	1.1E+01	--	--	2 HRS
VORVS	1	1.4E-08	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	600.0	1.0E+01	--	--	2 HRS
VOSVS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	2712.0	1.4E+03	--	--	2 HRS
VOWGS	1	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-08	2.2E+01	N/A	--	1392.0	3.5E+02	--	--	2 HRS
VOBGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	1760.0	2.2E+02	--	--	2 HRS
VODHS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	1152.0	6.0E+00	--	--	2 HRS
VOCGS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	153.6	1.6E+00	--	--	2 HRS
VOCHS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	307.2	3.2E+00	--	--	2 HRS
VOKGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	6000.0	1.5E+03	--	--	2 HRS
VOKHS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	6800.0	1.7E+03	--	--	2 HRS
VOKVS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	6400.0	1.6E+03	--	--	2 HRS
VOMVS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	1512.0	1.0E+01	--	--	2 HRS
VOPGS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	208.0	6.5E+00	--	--	2 HRS
VOPHS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	374.4	1.2E+01	--	--	2 HRS
VOPVS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	192.0	6.0E+00	--	--	2 HRS
VOQGS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	348.0	1.5E+01	--	--	2 HRS

See notes at end of table.

File: ONSITREG.WK1 Page 2 Date 19-Aug-87

ONSITE TRANSPORTATION - ONSITE PACKAGE - COLLOCATION OPTION
(MOVEMENT FROM STORAGE TO DEMIL FACILITY IN ONSITE PACKAGE)

Scenario Frequencies and Range Factors — Agent Available and Released

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VOQVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	348.0	1.5E+01	--	--	2 HRS
VORGS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	642.0	1.1E+01	--	--	2 HRS
VORVS	3	5.4E-11	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	600.0	1.0E+01	--	--	2 HRS
VOSVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	2712.0	1.4E+03	--	--	2 HRS
VOMGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.4E-11	2.6E+01	N/A	--	1392.0	3.5E+02	--	--	2 HRS
VOBHC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--	1152.0	--	2.9E+02	4.3E+01	20 MIN
VOCGC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--	153.6	--	3.8E+01	1.2E+01	20 MIN
VOCHC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--	307.2	--	7.7E+01	1.2E+01	20 MIN
VOMVC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--	1512.0	--	3.8E+02	4.5E+02	20 MIN
VOPGC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--	203.0	--	5.2E+01	2.6E+02	20 MIN
VOPHC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--	374.4	--	9.4E+01	1.2E+02	20 MIN
VOPVC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--	192.0	--	4.8E+01	2.8E+01	20 MIN
VOQGC	4	3.0E-12	1.4E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--	348.0	--	8.7E+01	1.6E+01	20 MIN
VOQVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	1.4E+02	N/A	--	348.0	--	8.7E+01	1.4E+01	20 MIN
VORGC	4	2.8E-10	3.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	3.3E+01	N/A	--	642.0	--	1.6E+02	3.6E+00	20 MIN
VORVC	4	2.8E-10	3.3E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	3.3E+01	N/A	--	600.0	--	1.5E+02	2.6E+01	20 MIN
VOBGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-14	1.6E+02	N/A	--	1760.0	--	--	1.8E+02	1 HR
VOKGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-14	1.6E+02	N/A	--	6000.0	--	--	6.0E+02	1 HR
VOKHF	5	2.8E-14	1.6E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-14	1.6E+02	N/A	--	6800.0	--	--	3.4E+02	1 HR
VOKVF	5	2.8E-14	1.6E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-14	1.6E+02	N/A	--	6400.0	--	--	1.6E+02	1 HR
VOSVF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-14	1.6E+02	N/A	--	2712.0	--	--	6.8E+01	1 HR
VOMGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-14	1.6E+02	N/A	--	1392.0	--	--	1.4E+02	1 HR
VOBGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	1760.0	1.5E+03	--	--	2 HRS
VOBHC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	1152.0	8.1E+02	1.7E+02	--	2 HRS
VOCGC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	153.6	1.1E+02	2.3E+01	--	2 HRS
VOCHC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	307.2	2.2E+02	4.6E+01	--	2 HRS
VOKGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	6000.0	5.1E+03	--	--	2 HRS
VOKHS	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	6800.0	5.8E+03	--	--	2 HRS
VOKVS	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	6400.0	5.4E+03	--	--	2 HRS

See notes at end of table.

File: ONSITREG.WK1 Page 3 Date 19-Aug-87

ONSITE TRANSPORTATION - ONSITE PACKAGE - COLLOCATION OPTION
(MOVEMENT FROM STORAGE TO DEMIL FACILITY IN ONSITE PACKAGE)

Scenario Frequencies and Range Factors | Agent Available and Released

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VOMVC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	1512.0	1.1E+03	2.3E+02	--	2 HRS
VOPGC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	208.0	1.5E+02	3.1E+01	--	2 HRS
VOPHC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	374.4	2.6E+02	5.6E+01	--	2 HRS
VOPVC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	192.0	1.3E+02	2.9E+01	--	2 HRS
VOQGC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	348.0	2.4E+02	5.2E+01	--	2 HRS
VOQVC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	348.0	2.4E+02	5.2E+01	--	2 HRS
VORGC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	642.0	4.5E+02	9.6E+01	--	2 HRS
VORVC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	600.0	4.2E+02	9.0E+01	--	2 HRS
VOSVS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	2712.0	2.3E+03	--	--	2 HRS
VOMGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	1392.0	1.2E+03	--	--	2 HRS
VOBGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	1.8E+03	--	--	1.8E+02	1 HR
VODHC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	1.2E+03	--	2.9E+02	4.3E+01	20 MIN
VOCGC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	1.5E+02	--	3.8E+01	1.2E+01	20 MIN
VOCHC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	3.1E+02	--	7.7E+01	1.2E+01	20 MIN
VOKGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	6.0E+03	--	--	6.0E+02	1 HR
VOKHF	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	6.8E+03	--	--	3.4E+02	1 HR
VOKVF	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	6.4E+03	--	--	1.6E+02	1 HR
VOMVC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	1.5E+03	--	3.8E+02	2.8E+01	20 MIN
VOPGC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	2.1E+02	--	5.2E+01	1.6E+01	20 MIN
VOPHC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	3.7E+02	--	9.4E+01	1.4E+01	20 MIN
VOPVC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	1.9E+02	--	4.8E+01	3.6E+00	20 MIN
VOQGC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	3.5E+02	--	8.7E+01	2.6E+01	20 MIN
VOQVC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	3.5E+02	--	8.7E+01	6.5E+00	20 MIN
VORGC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	6.4E+02	--	1.6E+02	4.8E+01	20 MIN
VORVC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	6.0E+02	--	1.5E+02	1.1E+01	20 MIN
VOSVF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	2.7E+03	--	--	6.8E+01	1 HR
VOWGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	1.4E+03	--	--	1.4E+02	1 HR
VOBGS	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	1760.0	2.2E+02	--	--	2 HRS
VODHS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	1152.0	6.0E+00	--	--	2 HRS

See notes at end of table.

File: ONSITREG.WK1 Page 4 Date 19-Aug-87

ONSITE TRANSPORTATION - ONSITE PACKAGE - COLLOCATION OPTION
(MOVEMENT FROM STORAGE TO DEMIL FACILITY IN ONSITE PACKAGE)

Scenario Frequencies and Range Factors | Agent Available and Released

SCEN-ARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VOCGS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	--	N/A	--	153.6	1.6E+00	--	--	2 HRS
VOCHS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	307.2	3.2E+00	--	--	2 HRS
VOKGS	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	6000.0	1.5E+03	--	--	2 HRS
VOKHS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	6800.0	1.7E+03	--	--	2 HRS
VOKVS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	6400.0	1.6E+03	--	--	2 HRS
VOMVS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	1512.0	1.0E+01	--	--	2 HRS
VOPGS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	208.0	6.5E+00	--	--	2 HRS
VOPHS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	374.4	1.2E+01	--	--	2 HRS
VOPVS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	192.0	6.0E+00	--	--	2 HRS
VOQGS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	348.0	1.5E+01	--	--	2 HRS
VOQVS	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	348.0	1.5E+01	--	--	2 HRS
VORGS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	642.0	1.1E+01	--	--	2 HRS
VORVS	9	6.0E-07	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	600.0	1.0E+01	--	--	2 HRS
VOSVS	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	2712.0	1.4E+03	--	--	2 HRS
VOWGS	9	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-05	1.1E+01	N/A	--	1392.0	3.5E+02	--	--	2 HRS
VOSSS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	1760.0	2.2E+02	--	--	6 HRS
VODHS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	1152.0	6.0E+00	--	--	6 HRS
VOCGS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	153.6	1.6E+00	--	--	6 HRS
VOCHS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	307.2	3.2E+00	--	--	6 HRS
VOKGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	6000.0	1.5E+03	--	--	6 HRS
VOKHS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	6800.0	1.7E+03	--	--	6 HRS
VOKVS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	6400.0	1.6E+03	--	--	6 HRS
VOMVS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	1512.0	1.0E+01	--	--	6 HRS
VOPGS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	208.0	6.5E+00	--	--	6 HRS
VOPHS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	374.4	1.2E+01	--	--	6 HRS
VOPVS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	192.0	6.0E+00	--	--	6 HRS
VOQGS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	348.0	1.5E+01	--	--	6 HRS
VOQVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	348.0	1.5E+01	--	--	6 HRS
VORGS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	642.0	1.1E+01	--	--	6 HRS

See notes at end of table.

File: ONSITREG.WK1 Page 5 Date 19-Aug-87

ONSITE TRANSPORTATION - ONSITE PACKAGE - COLLOCATION OPTION
(MOVEMENT FROM STORAGE TO DEMIL FACILITY IN ONSITE PACKAGE)

Scenario Frequencies and Range Factors | Agent Available and Released

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VORVS	11	2.4E-09	1.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	600.0	1.0E+01	--	--	6 HRS
VGSVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	2712.0	1.4E+03	--	--	6 HRS
VOWGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-08	1.4E+01	N/A	--	1392.0	3.5E+02	--	--	6 HRS
VODHC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--	1.2E+03	--	2.9E+02	4.3E+01	20 MIN
VOCGC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--	1.5E+02	--	3.8E+01	1.2E+01	20 MIN
VOCHC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--	3.1E+02	--	7.7E+01	1.2E+01	20 MIN
VOMVC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--	1.5E+03	--	3.8E+02	2.8E+01	20 MIN
VOPGC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--	2.1E+02	--	5.2E+01	1.6E+01	20 MIN
VOPHC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--	3.7E+02	--	9.4E+01	1.4E+01	20 MIN
VOPVC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--	1.9E+02	--	4.8E+01	3.6E+00	20 MIN
VOQGC	12	4.2E-13	1.0E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--	3.5E+02	--	8.7E+01	2.6E+01	20 MIN
VOQVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	8.8E+01	N/A	--	3.5E+02	--	8.7E+01	6.5E+00	20 MIN
VORGC	12	1.2E-08	1.7E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-07	2.0E+01	N/A	--	6.4E+02	--	1.6E+02	4.8E+01	20 MIN
VORVC	12	1.2E-08	1.7E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.0E-07	2.0E+01	N/A	--	6.0E+02	--	1.5E+02	1.1E+01	20 MIN
VOBGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	1.0E+02	N/A	--	1.8E+03	--	--	1.8E+02	1 HR
VOKGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	1.0E+02	N/A	--	6.0E+03	--	--	6.0E+02	1 HR
VOKHC	13	4.2E-13	1.1E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	1.0E+02	N/A	--	6.8E+03	--	--	3.4E+02	1 HR
VOKVC	13	4.2E-13	1.1E+02	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	1.0E+02	N/A	--	6.4E+03	--	--	1.6E+02	1 HR
VOSVC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	1.0E+02	N/A	--	1.4E+03	--	--	6.8E+01	1 HR
VOWGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	7.1E-12	1.0E+02	N/A	--	0.0E+00	--	--	1.4E+02	1 HR
VOBGC	14	N/A		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	1760.0	--	--	5.3E-01	2 HRS
VODHC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	1152.0	--	--	2.4E-02	2 HRS
VOCGC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	153.6	--	--	5.3E-01	2 HRS
VOCHC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	307.2	--	--	2.4E-02	2 HRS
VOKGS	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	6000.0	9.0E+02	--	--	2 HRS
VOKHS	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	6800.0	1.0E+03	--	--	2 HRS
VOKVS	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	6400.0	9.6E+02	--	--	2 HRS
VOMVC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	1512.0	--	--	2.0E-04	2 HRS
VOPGC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	208.0	--	--	5.3E-01	2 HRS

See notes at end of table.

ONSITE TRANSPORTATION - ONSITE PACKAGE - COLLOCATION OPTION
(MOVEMENT FROM STORAGE TO DEMIL FACILITY IN ONSITE PACKAGE)

Scenario Frequencies and Range Factors | Agent Available and Released

SCEN-ARIO	NO.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VOPHC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	374.4	--	--	2.4E-02	2 HRS
VOPVC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	192.0	--	--	2.0E-04	2 HRS
VOQGC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	348.0	--	--	5.3E-01	2 HRS
VOQVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	348.0	--	--	2.0E-04	2 HRS
VORGC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	642.0	--	--	5.3E-01	2 HRS
VORVC	14	1.1E-06	1.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	600.0	--	--	2.0E-04	2 HRS
VOSVS	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	2712.0	5.2E-15	--	--	2 HRS
VOWGC	14	N/A		N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.3E-09	1.3E+01	N/A	--	1392.0	--	--	5.3E-01	2 HRS
VODHC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--	1152.0	3.0E+01	6.0E+00	--	2 HRS
VOCGC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--	153.6	8.0E+00	1.6E+00	--	2 HRS
VOCHC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--	307.2	1.6E+01	3.2E+00	--	2 HRS
VOMVC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--	1512.0	1.5E+03	3.2E+01	--	2 HRS
VOPGC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--	208.0	3.2E+01	6.5E+00	--	2 HRS
VOPHC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--	374.4	5.8E+01	1.2E+01	--	2 HRS
VOPVC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--	192.0	3.0E+01	6.0E+00	--	2 HRS
VOQGC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--	348.0	7.3E+01	1.5E+01	--	2 HRS
VOQVC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--	348.0	7.3E+01	1.5E+01	--	2 HRS
VORGC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--	642.0	6.2E+02	2.1E+01	--	2 HRS
VORVC	15	2.4E-09	4.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.1E+01	N/A	--	600.0	5.8E+02	2.0E+01	--	2 HRS

NOTES: 1. Scenarios 1-5 are per truck mile; scenarios 6-15 are per exposure year.
2. Duration time shown for scenarios with agent releases due to both detonations and spills is for spills only. Duration time for detonation is instantaneous.
3. Scenarios 4 and 15 frequencies are multiplied by a factor to account for new undue force value.

File: ONSITREG.WK1 Page 1 Date 19-Aug-87

ONSITE TRANSPORTATION - REGIONAL AND NATIONAL DISPOSAL OPTIONS
(MOVEMENT TO AND FROM RAIL IN OFFSITE PACKAGE)

Scenario Frequencies and Range Factors | Agent Available and Released

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VRBGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	2.6E+03	2.2E+02	--	--	2 HRS
VRBHS	3	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	N/A	--	1.2E+03	6.0E+00	--	--	2 HRS
VRCGS	3	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	N/A	--	4.6E+02	1.6E+00	--	--	2 HRS
VRCHS	3	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	N/A	--	9.2E+02	3.2E+00	--	--	2 HRS
VRKGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	N/A	--	3.0E+03	1.5E+03	--	--	2 HRS
VRKHS	3	2.8E-10	2.2E+01	2.8E-10	2.2E+01	N/A	--	N/A	--	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	3.4E+03	1.7E+03	--	--	2 HRS
VRKVS	3	2.8E-10	2.2E+01	N/A	--	N/A	--	2.8E-10	2.2E+01	N/A	--	N/A	--	2.8E-10	2.2E+01	N/A	--	3.2E+03	1.6E+03	--	--	2 HRS
VRNVS	3	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	1.1E+03	1.0E+01	--	--	2 HRS
VRPGS	3	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	7.8E+02	6.5E+00	--	--	2 HRS
VRPHS	3	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	N/A	--	1.4E+03	1.2E+01	--	--	2 HRS
VRPVS	3	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	7.2E+02	6.0E+00	--	--	2 HRS
VRQGS	3	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	8.7E+02	1.5E+01	--	--	2 HRS
VRQVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	8.7E+02	1.5E+01	--	--	2 HRS
VRRGS	3	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	6.4E+02	1.1E+01	--	--	2 HRS
VRRVS	3	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	6.0E+02	1.3E+01	--	--	2 HRS
VRSVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	1.4E+03	1.4E+03	--	--	2 HRS
VRBHC	4	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	N/A	--	1.2E+03	--	2.9E+02	4.3E+01	20 MIN
VRCGC	4	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	N/A	--	4.6E+02	--	1.2E+02	3.5E+01	20 MIN
VRCHC	4	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	N/A	--	9.2E+02	--	2.3E+02	3.5E+01	20 MIN
VRNVC	4	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	1.1E+03	--	2.8E+02	2.1E+01	20 MIN
VRPGC	4	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	7.8E+02	--	2.0E+02	5.8E+01	20 MIN
VRPHC	4	3.0E-12	2.6E+01	N/A	--	3.0E-12	2.6E+01	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	N/A	--	1.4E+03	--	3.5E+02	5.3E+01	20 MIN
VRPVC	4	3.0E-12	2.6E+01	N/A	--	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	7.2E+02	--	1.8E+02	1.4E+01	20 MIN
VRQGC	4	3.0E-12	2.6E+01	N/A	--	3.0E-12	2.6E+01	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	8.7E+02	--	2.2E+02	6.5E+01	20 MIN
VRQVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	8.7E+02	--	2.2E+02	1.6E+01	20 MIN
VRRGC	4	2.2E-10	2.6E+01	N/A	--	2.2E-10	2.6E+01	N/A	--	2.2E-10	2.6E+01	N/A	--	2.2E-10	2.6E+01	2.2E-10	2.6E+01	6.4E+02	--	1.6E+02	4.8E+01	20 MIN
VRRVC	4	2.2E-10	2.6E+01	N/A	--	2.2E-10	2.6E+01	N/A	--	2.2E-10	2.6E+01	N/A	--	2.2E-10	2.6E+01	2.2E-10	2.6E+01	6.0E+02	--	1.5E+02	1.1E+01	20 MIN
VRBGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01	2.6E+03	2.2E+03	--	--	2 HR
VRBHC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	4.7E-09	2.0E+01	1.6E-10	2.0E+01	N/A	--	1.2E+03	8.1E+02	1.7E+02	--	2 HR

See notes at end of table.

File: ONSITREG.WK1 Page 2 Date 19-Aug-87

ONSITE TRANSPORTATION - REGIONAL AND NATIONAL DISPOSAL OPTIONS
(MOVEMENT TO AND FROM RAIL IN OFFSITE PACKAGE)

Scenario Frequencies and Range Factors — Agent Available and Released

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VRCGC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	4.6E+02	3.2E+02	6.9E+01	--	2 HR
VRCHC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	4.7E-09	2.0E+01	1.6E-10	2.0E+01	N/A	--	9.2E+02	6.5E+02	1.4E+02	--	2 HR
VRKGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	3.0E+03	2.6E+03	--	--	2 HR
VRKHS	6	6.0E-10	2.0E+01	7.2E-08	2.0E+01	N/A	--	N/A	--	1.1E-09	2.0E+01	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01	3.4E+03	2.9E+03	--	--	2 HR
VRKVS	6	6.0E-10	2.0E+01	N/A	--	N/A	--	5.0E-10	2.0E+01	N/A	--	N/A	--	1.6E-10	2.0E+01	N/A	--	3.2E+03	2.7E+03	--	--	2 HR
VRMVC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	1.1E-09	2.0E+01	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01	1.1E+03	7.9E+02	1.7E+02	--	2 HR
VRPGC	6	6.0E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01	7.8E+02	5.5E+02	1.2E+02	--	2 HR
VRPHC	6	6.0E-10	2.0E+01	N/A	--	2.7E-10	2.0E+01	N/A	--	N/A	--	4.7E-09	2.0E+01	1.6E-10	2.0E+01	N/A	--	1.4E+03	9.8E+02	2.1E+02	--	2 HR
VRPVC	6	6.0E-10	2.0E+01	N/A	--	2.7E-10	2.0E+01	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01	7.2E+02	5.0E+02	1.1E+02	--	2 HR
VRQGC	6	6.0E-10	2.0E+01	N/A	--	2.7E-10	2.0E+01	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01	8.7E+02	6.1E+02	1.3E+02		2 HR
VRQVC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01	8.7E+02	6.1E+02	1.3E+02		2 HR
VRRGC	6	6.0E-10	2.0E+01	N/A	--	2.7E-10	2.0E+01	N/A	--	1.1E-09	2.0E+01	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01	6.4E+02	4.5E+02	9.6E+01	--	2 HR
VRRVC	6	6.0E-10	2.0E+01	N/A	--	2.7E-10	2.0E+01	N/A	--	1.1E-09	2.0E+01	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01	6.0E+02	4.2E+02	9.0E+01	--	2 HR
VRSVS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-10	2.0E+01	1.0E-09	2.0E+01	1.4E+03	1.2E+03	--	--	2 HR
VRBGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01	2.6E+03	--	--	2.6E+02	1 HR
VRDHC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-09	2.0E+01	1.3E-10	2.0E+01	N/A	--	1.2E+03	--	2.9E+02	4.3E+01	20 MIN
VRCGC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	4.6E+02	--	1.2E+02	3.5E+01	20 MIN
VRCHC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	3.9E-09	2.0E+01	1.3E-10	2.0E+01	N/A	--	9.2E+02	--	2.3E+02	3.5E+01	20 MIN
VRKGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	3.0E+03	--	--	3.0E+02	1 HR
VRKHF	7	4.9E-10	2.0E+01	5.9E-08	2.0E+01	N/A	--	N/A	--	9.1E-10	2.0E+01	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01	3.4E+03	--	--	1.7E+02	1 HR
VRKVF	7	4.9E-10	2.0E+01	N/A	--	N/A	--	4.1E-10	2.0E+01	N/A	--	N/A	--	1.3E-10	2.0E+01	N/A	--	3.2E+03	--	--	8.0E+01	1 HR
VRMVC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	9.1E-10	2.0E+01	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01	1.1E+03	--	2.8E+02	2.1E+01	20 MIN
VRFGC	7	4.9E-10	2.0E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01	7.8E+02	--	2.0E+02	5.8E+01	20 MIN
VRPHC	7	4.9E-10	2.0E+01	N/A	--	2.3E-10	2.0E+01	N/A	--	N/A	--	3.9E-09	2.0E+01	1.3E-10	2.0E+01	N/A	--	1.4E+03	--	3.5E+02	5.3E+01	20 MIN
VRPVC	7	4.9E-10	2.0E+01	N/A	--	2.3E-10	2.0E+01	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01	7.2E+02	--	1.8E+02	1.4E+01	20 MIN
VRQGC	7	4.9E-10	2.0E+01	N/A	--	2.3E-10	2.0E+01	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01	8.7E+02	--	2.2E+02	6.5E+01	20 MIN
VRQVC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01	8.7E+02	--	2.2E+02	1.6E+01	20 MIN
VRRGC	7	4.9E-10	2.0E+01	N/A	--	2.3E-10	2.0E+01	N/A	--	9.1E-10	2.0E+01	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01	6.4E+02	--	1.6E+02	4.8E+01	20 MIN
VRRVC	7	4.9E-10	2.0E+01	N/A	--	2.3E-10	2.0E+01	N/A	--	9.1E-10	2.0E+01	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01	6.0E+02	--	1.5E+02	1.1E+01	20 MIN

See notes at end of table.

File: ONSITREG.WK1 Page 3 Date 19-Aug-87

ONSITE TRANSPORTATION - REGIONAL AND NATIONAL DISPOSAL OPTIONS
(MOVEMENT TO AND FROM RAIL IN OFFSITE PACKAGE)

Scenario Frequencies and Range Factors

SCEN-ARIO	No.	AMAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR
VRSVF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
VRBGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
VRDHS	11	1.2E-08	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--
VRCGS	11	1.2E-08	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--
VRCHS	11	1.2E-08	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--
VRKGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
VRKHS	11	1.2E-08	1.1E+01	1.2E-08	1.1E+01	N/A	--	N/A	--	1.2E-08	1.1E+01
VRKVS	11	1.2E-08	1.1E+01	N/A	--	N/A	--	4.1E-08	1.1E+01	N/A	--
VRMVS	11	1.2E-08	1.1E+01	N/A	--	N/A	--	N/A	--	1.2E-08	1.1E+01
VRPGS	11	9.8E-08	1.1E+01	N/A	--	N/A	--	N/A	--	N/A	--
VRPHS	11	9.8E-08	1.1E+01	N/A	--	9.8E-08	1.1E+01	N/A	--	N/A	--
VRPVS	11	9.8E-08	1.1E+01	N/A	--	9.8E-08	1.1E+01	N/A	--	N/A	--
VRQGS	11	9.8E-08	1.1E+01	N/A	--	9.8E-08	1.1E+01	N/A	--	N/A	--
VRQVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
VRRGS	11	1.2E-08	1.1E+01	N/A	--	1.2E-08	1.1E+01	N/A	--	1.2E-08	1.1E+01
VRRVS	11	1.2E-08	1.1E+01	N/A	--	1.2E-08	1.1E+01	N/A	--	1.2E-08	1.1E+01
VRSVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
VRDHC	12	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--
VRCGC	12	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--
VRCHC	12	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--
VRMVC	12	0.0E+00	--	N/A	--	N/A	--	N/A	--	0.0E+00	--
VRPGC	12	0.0E+00	--	N/A	-	N/A	--	N/A	--	N/A	--
VRPHC	12	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--
VRPVC	12	0.0E+00	--	N/A	--	0.0E+00	--	N/A	--	N/A	--
VRQGC	12	0.0E+00	--	N/A	-	0.0E+00	--	N/A	--	N/A	--
VRQVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--
VRRGC	12	9.6E-09	2.0E+01	N/A	--	9.6E-09	2.0E+01	N/A	--	9.6E-09	2.0E+01
VRPVC	12	9.6E-09	2.0E+01	N/A	--	9.6E-09	2.0E+01	N/A	--	9.6E-09	2.0E+01
VRBGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--

Agent Available and Released

SCEN-ARIO	No.	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VRSVF	7	N/A	--	1.3E-10	2.0E+01	8.5E-10	2.0E+01	1.4E+03	--	--	3.4E+01	1 HR
VRBGS	11	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01	2.6E+03	2.2E+02	--	--	6 HRS
VRDHS	11	1.2E-08	1.1E+01	2.0E-07	1.1E+01	N/A	--	1.2E+03	6.0E+00			6 HRS
VRCGS	11	N/A	--	2.0E-07	1.1E+01	N/A	--	4.6E+02	1.6E+00	--	--	6 HRS
VRCHS	11	1.2E-08	1.1E+01	2.0E-07	1.1E+01	N/A	--	9.2E+02	3.2E+00	--	--	6 HRS
VRKGS	11	N/A	--	2.0E-07	1.1E+01	N/A	--	3.0E+03	1.5E+03	--	--	6 HRS
VRKHS	11	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01	3.4E+03	1.7E+03	--	--	6 HRS
VRKVS	11	N/A	--	2.0E-07	1.1E+01	N/A	--	3.2E+03	1.6E+03	--	--	6 HRS
VRMVS	11	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01	1.1E+03	1.0E+01	--	--	6 HRS
VRPGS	11	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01	7.8E+02	6.5E+00	--	--	6 HRS
VRPHS	11	1.2E-08	1.1E+01	2.0E-07	1.1E+01	N/A	--	1.4E+03	1.2E+01	--	--	6 HRS
VRPVS	11	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01	7.2E+02	6.0E+00	--	--	6 HRS
VRQGS	11	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01	8.7E+02	1.5E+01	--	--	6 HRS
VRQVS	11	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01	8.7E+02	1.5E+01	--	--	6 HRS
VRRGS	11	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01	6.4E+02	1.1E+01	--	--	6 HRS
VRRVS	11	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01	6.0E+02	1.0E+01	--	--	6 HRS
VRSVS	11	N/A	--	2.0E-07	1.1E+01	1.2E-08	1.1E+01	1.4E+03	1.4E+03	--	--	6 HRS
VRDHC	12	0.0E+00	--	0.0E+00	--	N/A	--	1.2E+03	--	2.9E+02	4.3E+01	20 MIN
VRCGC	12	N/A	--	0.0E+00	--	N/A	--	4.6E+02	--	1.2E+02	3.5E+01	20 MIN
VRCHC	12	0.0E+00	--	0.0E+00	--	N/A	--	9.2E+02	--	2.3E+02	3.5E+01	20 MIN
VRMVC	12	N/A	--	0.0E+00	--	0.0E+00	--	1.1E+03	--	2.8E+02	2.1E+01	20 MIN
VRPGC	12	N/A	--	0.0E+00	--	0.0E+00	--	7.8E+02	--	2.0E+02	5.8E+01	20 MIN
VRPHC	12	0.0E+00	--	0.0E+00	--	N/A	--	1.4E+03	--	3.5E+02	5.3E+01	20 MIN
VRPVC	12	N/A	--	0.0E+00	--	0.0E+00	--	7.2E+02	--	1.8E+02	1.4E+01	20 MIN
VRQGC	12	N/A	--	0.0E+00	--	0.0E+00	--	8.7E+02	--	2.2E+02	6.5E+01	20 MIN
VRQVC	12	N/A	--	0.0E+00	--	0.0E+00	--	8.7E+02	--	2.2E+02	1.6E+01	20 MIN
VRRGC	12	N/A	--	1.6E-07	1.6E+01	9.6E-09	2.0E+01	6.4E+02	--	1.6E+02	4.8E+01	20 MIN
VRPVC	12	N/A	--	1.6E 07	1.6E+01	9.6E-09	2.0E+01	6.0E+02	--	1.5E+02	1.1E+01	20 MIN
VRBGC	13	N/A	--	0.0E+00	--	0.0E+00	--	2.6E+03	--	--	2.6E+02	1 HR

See .otes at end of table.

File: ONSITREG.WK1 Page 4 Date 19-Aug-87

ONSITE TRANSPORTATION - REGIONAL AND NATIONAL DISPOSAL OPTIONS
(MOVEMENT TO AND FROM RAIL IN OFFSITE PACKAGE)

Scenario Frequencies and Range Factors — Agent Available and Released

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VRKGC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	3.0E+03	--	--	3.0E+02	1 HR
VRKHC	13	0.0E+00	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	0.0E+00	--	0.0E+00	--	3.4E+03	--	--	1.7E+02	1 HR
VRKVC	13	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	N/A	--	0.0E+00	--	N/A	--	3.2E+03	--	--	8.0E+01	1 HR
VRSVC	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	0.0E+00	--	0.0E+00	--	1.4E+03	--	--	3.4E+01	1 HR
VRWGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01	2.6E+03	--	--	5.5E+00	2 HR
VRDHC	14	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	2.4E+01	6.8E-11	2.5E+01	N/A	--	1.2E+03	--	--	2.5E-01	2 HR
VRCGC	14	0.0E+00	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	N/A	--	4.6E+02	--	--	3.2E+00	2 HR
VRCHC	14	2.1E-08	2.5E+01	N/A	--	N/A	--	N/A	--	N/A	--	1.1E-09	2.4E+01	6.8E-11	2.5E+01	N/A	--	9.2E+02	--	--	2.5E-01	2 HR
VRKGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	N/A	--	3.0E+03	--	--	5.5E+00	2 HR
VRKHC	14	2.1E-08	2.5E+01	1.1E-09	2.4E+01	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01	3.4E+03	--	--	2.5E-01	2 HR
VRKVC	14	2.1E-08	2.5E+01	N/A	--	N/A	--	2.1E-08	2.5E+01	N/A	--	N/A	--	6.8E-11	2.5E+01	N/A	--	3.2E+03	--	--	2.1E-03	2 HR
VRMVC	14	2.1E-08	2.5E+01	N/A	--	N/A	--	N/A	--	2.1E-08	2.5E+01	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01	1.1E+03	--	--	2.1E-03	2 HR
VRPGC	14	2.1E-08	2.5E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01	7.8E+02	--	--	5.5E+00	2 HR
VRPHC	14	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	N/A	--	1.1E-09	2.4E+01	6.8E-11	2.5E+01	N/A	--	1.4E+03	--	--	2.5E-01	2 HR
VRPVC	14	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01	7.2E+02	--	--	2.1E-03	2 HR
VRQGC	14	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01	8.7E+02	--	--	5.5E+00	2 HR
VRQVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01	8.7E+02	--	--	2.1E-03	2 HR
VRRGC	14	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01	6.4E+02	--	--	5.5E+00	2 HR
VRRVC	14	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	2.1E-08	2.5E+01	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01	6.0E+02	--	--	2.1E-03	2 HR
VRSVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.8E-11	2.5E+01	6.8E-11	2.5E+01	1.4E+03	--	--	2.1E-03	2 HR
VRDHC	15	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-10	4.9E+01	2.2E-09	5.8E+01	N/A	--	1.2E+03	3.0E+01	6.0E+00	--	2 HR
VRCGC	15	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.8E+01	N/A	--	4.6E+02	8.0E+00	1.6E+00	--	2 HR
VRCHC	15	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	N/A	--	2.6E-10	4.9E+01	2.2E-09	5.8E+01	N/A	--	9.2E+02	1.6E+01	3.2E+00	--	2 HR
VRMVC	15	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	3.7E-10	5.5E+01	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01	1.1E+03	1.1E+03	3.2E+01	--	2 HR
VRPGC	15	3.7E-10	5.5E+01	N/A	-	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01	7.8E+02	3.2E+01	6.5E+00	--	2 HR
VRPHC	15	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	N/A	--	2.6E-10	4.9E+01	2.2E-09	5.8E+01	N/A	--	1.4E+03	5.8E+01	1.2E+01	--	2 HR
VRPVC	15	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01	7.2E+02	3.0E+01	6.0E+00	--	2 HR
VRUGC	15	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	N/A	--	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01	8.7E+02	7.3E+01	1.5E+01	--	2 HR
VRQVC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01	8.7E+02	7.3E+01	1.5E+01	--	2 HR

See notes at end of table.

File: ONSITREG.WK1 Page 5 Date 19-Aug-87

ONSITE TRANSPORTATION - REGIONAL AND NATIONAL DISPOSAL OPTIONS
(MOVEMENT TO AND FROM RAIL IN OFFSITE PACKAGE)

Scenario Frequencies and Range Factors

Agent Available and Released

SCEN-ARIO	No.	ANAD FREQ	RANGE FACTOR	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	NAAP FREQ	RANGE FACTOR	PBA FREQ	RANGE FACTOR	PUDA FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	UMDA FREQ	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VRRGC	15	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01	6.4E+02	6.2E+02	2.1E+01	--	2 HR
VRRVC	15	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	3.7E-10	5.5E+01	N/A	--	2.2E-09	5.8E+01	1.4E-10	5.8E+01	6.0E+02	5.8E+02	2.0E+01	--	2 HR

NOTES: 1. Scenarios 1-5 are per truck mile; scenarios 6-15 are per exposure year.
2. Duration time shown for scenarios with agent releases due to both detonations and spills is for spills only. Duration time for detonation is instantaneous.
3. National Disposal Option VRKVS ANAD is N/A.
4. Scenarios 4 and 15 frequencies are multiplied by a factor to account for new undue force value.

File: ONSITBRG.WK1 Page 1 Date 19-Aug-87

ONSITE TRANSPORTATION - AIR

Scenario Frequencies and Range Factors — Agent Available and Released

SCENARIO	NO.	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	AGENT AVAIL	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VAKHS	1	0.0E+00	--	N/A	--	0.0E+00	--	3.4E+03	--	--	--	--
VAPHS	1	N/A	--	0.0E+00	--	0.0E+00	--	1.4E+03	--	--	--	--
VAPVS	1	N/A	--	0.0E+00	--	0.0E+00	--	7.6E+02	--	--	--	--
VAQGS	1	N/A	--	0.0E+00	--	0.0E+00	--	8.7E+02	--	--	--	--
VARGS	1	N/A	--	0.0E+00	--	0.0E+00	--	6.5E+02	--	--	--	--
VARVS	1	N/A	--	0.0E+00	--	0.0E+00	--	6.1E+02	--	--	--	--
VAKHS	2	0.0E+00	--	N/A	--	0.0E+00	--	3.4E+03	--	--	--	--
VAPHS	2	N/A	--	0.0E+00	--	0.0E+00	--	1.4E+03	--	--	--	--
VAPVS	2	N/A	--	0.0E+00	--	0.0E+00	--	7.6E+02	--	--	--	--
VAQGS	2	N/A	--	0.0E+00	--	0.0E+00	--	8.7E+02	--	--	--	--
VARGS	2	N/A	--	0.0E+00	--	0.0E+00	--	6.5E+02	--	--	--	--
VARVS	2	N/A	--	0.0E+00	--	0.0E+00	--	6.1E+02	--	--	--	--
VAKHS	3	2.8E-10	2.2E+01	N/A	--	2.8E-10	2.2E+01	3.4E+03	1.7E+03	--	--	2 HRS
VAPHS	3	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	1.4E+03	1.2E+01	--	--	2 HRS
VAPVS	3	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	7.2E+02	6.0E+00	--	--	2 HRS
VAQGS	3	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	8.7E+02	1.5E+01	--	--	2 HRS
VARGS	3	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	6.4E+02	1.1E+01	--	--	2 HRS
VARVS	3	N/A	--	2.8E-10	2.2E+01	2.8E-10	2.2E+01	6.0E+02	1.0E+01	--	--	2 HRS
VAPHC	4	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	1.4E+03	--	3.5E+02	5.3E+01	20 MIN
VAPVC	4	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	7.2E+02	--	1.8E+02	1.4E+01	20 MIN
VAQGC	4	N/A	--	3.0E-12	2.6E+01	3.0E-12	2.6E+01	8.7E+02	--	2.2E+02	6.5E+01	20 MIN
VARGC	4	N/A	--	2.2E-10	2.6E+01	2.2E-10	2.6E+01	6.4E+02	--	1.6E+02	4.8E+01	20 MIN
VARVC	4	N/A	--	2.2E-10	2.6E+01	2.2E-10	2.6E+01	6.0E+02	--	1.5E+02	1.1E+01	20 MIN
VAKHF	5	0.0E+00	--	N/A	--	0.0E+00	--	3.4E+03	--	--	--	--
VAKHS	6	7.2E-08	2.0E+01	N/A	--	4.8E-09	2.0E+01	3.4E+03	2.9E+03	--	--	2 HR
VAPHC	6	N/A	--	2.7E-10	2.0E+01	4.8E-09	2.0E+01	1.4E+03	9.8E+02	2.1E+02	--	2 HR
VAPVC	6	N/A	--	2.7E-10	2.0E+01	4.8E-09	2.0E+01	7.2E+02	5.0E+02	1.1E+02	--	2 HR
VAQGC	6	N/A	--	2.7E-10	2.0E+01	4.6E-09	2.0E+01	8.7E+02	6.1E+02	1.3E+02		2 HR
VARGC	6	N/A	--	2.7E-10	2.0E+01	4.8E-09	2.0E+01	6.4E+02	4.5E+02	9.6E+01	--	2 HR

File: ONSITBRG.WK1 Page 2 Date 19-Aug-87

ONSITE TRANSPORTATION - AIR

Scenario Frequencies and Range Factors Agent Available and Released

SCENARIO	NO.	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	AGENT AVAIL	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VARVC	6	N/A	--	2.7E-10	2.0E+01	4.8E-09	2.0E+01	6.0E+02	4.2E+02	9.0E+01	--	2 HR
VAKHF	7	5.9E-08	2.0E+01	N/A	--	4.0E-09	2.0E+01	3.4E+03	--	--	1.7E+02	1 HR
VAPHC	7	N/A	--	2.3E-10	2.0E+01	4.0E-09	2.0E+01	1.4E+03	--	3.5E+02	5.3E+01	20 MIN
VAPVC	7	N/A	--	2.3E-10	2.0E+01	4.0E-09	2.0E+01	7.2E+02	--	1.8E+02	1.4E+01	20 MIN
VAQGC	7	N/A	--	2.3E-10	2.0E+01	4.0E-09	2.0E+01	8.7E+02	--	2.2E+02	6.5E+01	20 MIN
VARGC	7	N/A	--	2.3E-10	2.0E+01	4.0E-09	2.0E+01	6.4E+02	--	1.6E+02	4.8E+01	20 MIN
VARVC	7	N/A	--	2.3E-10	2.0E+01	4.0E-09	2.0E+01	6.0E+02	--	1.5E+02	1.1E+01	20 MIN
VAKHS	9	0.0E+00	--	N/A	--	0.0E+00	--	3.4E+03	--	--	--	--
VAPHS	9	N/A	--	0.0E+00	--	0.0E+00	--	1.4E+03	--	--	--	--
VAPVS	9	N/A	--	0.0E+00	--	0.0E+00	--	7.2E+02	--	--	--	--
VAQGS	9	N/A	--	0.0E+00	--	0.0E+00	--	8.7E+02	--	--	--	--
VARGS	9	N/A	--	0.0E+00	--	0.0E+00	--	6.4E+02	--	--	--	--
VARVS	9	N/A	--	0.0E+00	--	0.0E+00	--	6.0E+02	--	--	--	--
VAKHS	10	0.0E+00	--	N/A	--	0.0E+00	--	3.4E+03	--	--	--	--
VAPHS	10	N/A	--	0.0E+00	--	0.0E+00	--	1.4E+03	--	--	--	--
VAPVS	10	N/A	--	0.0E+00	--	0.0E+00	--	7.2E+02	--	--	--	--
VAQGS	10	N/A	--	0.0E+00	--	0.0E+00	--	8.7E+02	--	--	--	--
VARGS	10	N/A	--	0.0E+00	--	0.0E+00	--	6.4E+02	--	--	--	--
VARVS	10	N/A	--	0.0E+00	--	0.0E+00	--	6.0E+02	--	--	--	--
VAKHS	11	1.2E-08	2.2E+01	N/A	--	2.0E-07	2.2E+01	3.4E+03	1.7E+03	--	--	6 HRS
VAPHS	11	N/A	--	1.2E-08	2.2E+01	2.0E-07	2.2E+01	1.4E+03	1.2E+01	--	--	6 HRS
VAPVS	11	N/A	--	1.2E-08	2.2E+01	2.0E-07	2.2E+01	7.2E+02	6.0E+00	--	--	6 HRS
VAQGS	11	N/A	--	1.2E-08	2.2E+01	2.0E-07	2.2E+01	8.7E+02	1.5E+01	--	--	6 HRS
VARGS	11	N/A	--	1.2E-08	2.2E+01	2.0E-07	2.2E+01	6.4E+02	1.1E+01	--	--	6 HRS
VARVS	11	N/A	--	1.2E-08	2.2E+01	2.0E-07	2.2E+01	6.0E+02	1.0E+01	--	--	6 HRS
VAPHC	12	N/A	--	0.0E+00	--	0.0E+00	--	1.4E+03	--	3.5E+02	5.3E+01	20 MIN
VAPVC	12	N/A	--	0.0E+00	--	0.0E+00	--	7.2E+02	--	1.8E+02	1.4E+01	20 MIN
VAQGC	12	N/A	--	0.0E+00	--	0.0E+00	--	8.7E+02	--	2.2E+02	6.5E+01	20 MIN
VARGC	12	N/A	--	9.6E-09	2.0E+01	1.6E-07	2.0E+01	6.4E+02	--	1.6E+02	4.8E+01	20 MIN

File: ONSITBRG.WK1 Page 1 Date 19-Aug-87

ONSITE TRANSPORTATION - AIR

Scenario Frequencies and Range Factors — Agent Available and Released

SCENARIO	NO.	APG FREQ	RANGE FACTOR	LBAD FREQ	RANGE FACTOR	TEAD FREQ	RANGE FACTOR	AGENT AVAIL	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
VARVC	12	N/A	--	9.6E-09	2.0E+01	1.6E-07	2.0E+01	6.0E+02	--	1.5E+02	1.1E+01	20 MIN
VAKHF	13	0.0E+00	--	N/A	--	0.0E+00	--	3.4E+03	--	--	1.7E+02	1 HR
VAKHC	14	1.1E-09	2.4E+01	N/A	--	6.8E-11	2.5E+01	3.4E+03	--	--	2.5E-01	2 HR
VAPHC	14	N/A	--	2.1E-08	2.5E+01	6.8E-11	2.5E+01	1.4E+03	--	--	2.5E-01	2 HR
VAPVC	14	N/A	--	2.1E-08	2.5E+01	6.8E-11	2.5E+01	7.2E+02	--	--	2.1E-03	2 HR
VABGC	14	N/A	--	2.1E-08	2.5E+01	6.8E-11	2.5E+01	8.7E+02	--	--	5.5E+00	2 HR
VARGC	14	N/A	--	2.1E-08	2.5E+01	6.8E-11	2.5E+01	6.4E+02	--	--	5.5E+00	2 HR
VARVC	14	N/A	--	2.1E-08	2.5E+01	6.8E-11	2.5E+01	6.0E+02	--	--	2.1E-03	2 HR
VAPHC	15	N/A	--	3.7E-10	5.5E+01	2.2E-09	5.8E+01	1.4E+03	5.8E+01	1.2E+01	--	2 HR
VAPVC	15	N/A	--	3.7E-10	5.5E+01	2.2E-09	5.8E+01	7.2E+02	3.0E+01	6.0E+00	--	2 HR
VABGC	15	N/A	--	3.7E-10	5.5E+01	2.2E-09	5.8E+01	8.7E+02	7.3E+01	1.5E+01	--	2 HR
VARGC	15	N/A	--	3.7E-10	5.5E+01	2.2E-09	5.8E+01	6.4E+02	6.2E+02	2.1E+01	--	2 HR
VARVC	15	N/A	--	3.7E-10	5.5E+01	2.2E-09	5.8E+01	6.0E+02	5.8E+02	2.0E+01	--	2 HR

I.1.6. OFFSITE TRANSPORT

The following tables list the accident results for offsite transport of munitions.

Page 1   Date 20-Aug-87

OFFSITE TRANSPORTATION - REGIONAL DISPOSAL OPTION

Accident Frequencies and Range Factors — Agent Available and Released

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
RCBGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	5.3E+03	2.2E+02	--	--	6 HRS
RCDHS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	2.3E+03	6.0E+00	--	--	6 HRS
RCLGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	--	--	--	--
RCCHS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	1.8E+03	3.2E+00	--	--	6 HRS
RCAGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCAHS	3	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	6.8E+03	1.7E+03	--	--	6 HRS
RCNVS	3	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	1.8E+03	--	--	6 HRS
RCMVS	3	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	2.3E+03	1.0E+01	--	--	6 HRS
RCPGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	1.6E+03	6.5E+00	--	--	6 HRS
RCPHS	3	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	2.8E+03	1.2E+01	--	--	6 HRS
RCPVS	3	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	1.4E+03	6.0E+00	--	--	6 HRS
RCOGS	3	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	1.7E+03	1.5E+01	--	--	6 HRS
RCOVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	1.7E+03	1.5E+01	--	--	6 HRS
RCRGS	3	N/A	--	N/A	--	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	1.3E+03	1.1E+01	--	--	6 HRS
RCRVS	3	N/A	--	N/A	--	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	1.2E+03	1.0E+01	--	--	6 HRS
RCSVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	2.7E+03	--	--	--	--
RCDHC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	23	N/A	--	N/A	--	2.3E+03	--	2.9E+02	4.3E+01	20 min
RCLGC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	--	--	--	--
RCCHC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	23	N/A	--	N/A	--	1.8E+03	--	2.3E+02	3.5E+01	20 min
RCMVC	4	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	21	N/A	--	N/A	--	4.4E-10	21	2.3E+03	--	2.8E+02	2.1E+01	20 min
RCPGC	4	N/A	--	N/A	--	N/A		N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27	1.6E+03	--	2.0E+02	5.8E+01	20 min
RCPHC	4	N/A	--	N/A	--	4.4E-10	27	N/A	--	N/A	--	4.4E-10	27	N/A	--	N/A	--	2.8E+03	--	3.5E+02	5.3E+01	20 min
RCPVC	4	N/A	--	N/A	--	4.4E-10	27	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27	1.4E+03	--	1.8E+02	1.4E+01	20 min
RCQGC	4	N/A	--	N/A	--	4.4E-10	27	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27	1.7E+03	--	2.2E+02	6.5E+01	20 min
RCOVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27	1.7E+03	--	2.2E+02	1.6E+01	20 min
RCRGC	4	N/A	--	N/A	--	4.5E-10	21	N/A	--	4.5E-10	21	N/A	--	N/A	--	4.5E-10	21	1.3E+03	--	1.6E+02	4.8E+01	20 min
RCRVC	4	N/A	--	N/A	--	4.5E-10	21	N/A	--	4.5E-10	21	N/A	--	N/A	--	4.5E-10	21	1.2E+03	--	1.5E+02	1.1E+01	20 min
RCBGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-10	47	5.3E+03	--	--	2.6E+02	2 HRS
RCAGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--

See notes at end of table.

OFFSITE TRANSPORTATION - REGIONAL DISPOSAL OPTION

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
		Accident Frequencies and Range Factors																Agent Available and Released				
RCFHF	5	N/A	--	3.5E-10	47	N/A	--	N/A	--	3.5E-10	47	N/A	--	N/A	--	3.5E-10	47	6.8E+03	--	--	1.7E+02	2 HRS
RCFVF	5	N/A	--	N/A	--	N/A	--	3.5E-10	47	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	--	--	9.0E+01	2 HRS
RCSVF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-10	47	2.7E+03	--	--	3.4E+01	2 HRS
RCBGS	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	5.3E+03	9.0E+03	--	--	6 HRS
RCDHC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	2.3E+03	3.2E+03	6.9E+02	--	6 HRS
RCDGC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	--	--	--	--
RCCHC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.8E+03	2.6E+03	5.5E+02	--	6 HRS
RCFGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCFHS	6	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	6.8E+03	1.2E+04	--	--	6 HRS
RCFVS	6	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	1.2E+04	--	--	6 HRS
RCMVC	6	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	2.3E+03	3.2E+03	6.8E+02	--	6 HRS
RCFGC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	1.6E+03	2.2E+03	4.7E+02	--	6 HRS
RCFHC	6	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	2.8E+03	3.9E+03	8.4E+02	--	6 HRS
RCFVC	6	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	1.4E+03	2.0E+03	4.3E+02	--	6 HRS
RCDGC	6	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	1.7E+03	2.4E+03	5.2E+02	--	6 HRS
RCEVC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	1.7E+03	2.4E+03	5.2E+02	--	6 HRS
RCMGC	6	N/A	--	N/A	--	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	1.3E+03	1.8E+03	3.9E+02	--	6 HRS
RCRVC	6	N/A	--	N/A	--	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	1.2E+03	1.7E+03	3.6E+02	--	6 HRS
RCSVS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	2.7E+03	4.6E+03	--	--	6 HRS
RCBGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	5.3E+03	--	--	1.1E+03	1 HR
RCDHC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	2.3E+03	--	1.2E+03	1.7E+02	20 MIN
RCDGC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	--	--	--	--
RCCHC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.8E+03	--	9.2E+02	1.4E+02	20 MIN
RCFGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCFHF	7	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	6.8E+03	--	--	6.8E+02	1 HR
RCFVF	7	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	--	--	3.6E+02	1 HR
RCMVC	7	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	2.3E+03	--	1.1E+03	8.5E+01	20 MIN
RCPGC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	1.6E+03	--	7.8E+02	2.3E+02	20 MIN
RCFHC	7	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	2.8E+03	--	1.4E+03	2.1E+02	20 MIN

See notes at end of table.

OFFSITE TRANSPORTATION - REGIONAL DISPOSAL OPTION

Accident Frequencies and Range Factors

Agent Available and Released

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
RCPVC	7	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	1.4E+03	--	7.2E+02	5.4E+01	20 MIN
RCQGC	7	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	1.7E+03	--	8.7E+02	2.6E+02	20 MIN
RCOVC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	1.7E+03	--	8.7E+02	6.5E+01	20 MIN
RCRGC	7	N/A	--	N/A	--	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	1.3E+03	--	6.4E+02	1.9E+02	20 MIN
RCRVC	7	N/A	--	N/A	--	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	1.2E+03	--	6.0E+02	4.5E+01	20 MIN
RCSVF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	2.7E+03	--	--	1.4E+02	1 HR
RCBGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37	5.3E+03	2.2E+02	--	--	6 HRS
RCDHS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-07	37	N/A	--	N/A	--	2.3E+03	6.0E+00	--	--	6 HRS
RCCGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	--	--	--	--
RCCHS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-07	37	N/A	--	N/A	--	1.8E+03	3.2E+00	--	--	6 HRS
RCKGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCKHS	11	N/A	--	1.1E-07	37	N/A	--	N/A	--	3.1E-07	37	N/A	--	N/A	--	4.8E-07	37	6.8E+03	1.7E+03	--	--	6 HRS
RCKVS	11	N/A	--	N/A	--	N/A	--	1.7E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	1.8E+03	--	--	6 HRS
RCMVS	11	N/A	--	N/A	--	N/A	--	N/A	--	3.1E-07	37	N/A	--	N/A	--	4.8E-07	37	2.3E+03	1.0E+01	--	--	6 HRS
RCFGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37	1.6E+03	6.5E+00	--	--	6 HRS
RCFHS	11	N/A	--	N/A	--	1.6E-07	37	N/A	--	N/A	--	1.5E-07	37	N/A	--	N/A	--	2.8E+03	1.2E+01	--	--	6 HRS
RCPVS	11	N/A	--	N/A	--	1.6E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37	1.4E+03	6.0E+00	--	--	6 HRS
RCQGS	11	N/A	--	N/A	--	1.6E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37	1.7E+03	1.5E+01	--	--	6 HRS
RCOVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37	1.7E+03	1.5E+01	--	--	6 HRS
RCRGS	11	N/A	--	N/A	--	1.6E-07	37	N/A	--	3.1E-07	37	N/A	--	N/A	--	4.8E-07	37	1.3E+03	1.1E+01	--	--	6 HRS
RCRVS	11	N/A	--	N/A	--	1.6E-07	37	N/A	--	3.1E-07	37	N/A	--	N/A	--	4.8E-07	37	1.2E+03	1.0E+01	--	--	6 HRS
RCSVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37	2.7E+03	1.4E+03	--	--	6 HRS
RCDHC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	10	N/A	--	N/A	--	2.3E+03	--	2.9E+02	4.3E+01	20 MIN
RCLGC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	--	--	--	--
RCCHC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	10	N/A	--	N/A	--	1.8E+03	--	2.3E+02	3.5E+01	20 MIN
RCMVC	12	N/A	--	N/A	--	N/A	--	N/A	--	3.4E-08	51	N/A	--	N/A	--	5.3E-08	71	2.3E+03	--	2.8E+02	2.1E+01	20 MIN
RCPGC	12	N/A	--	N/A	--	N/A		N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73	1.6E+03	--	2.0E+02	5.8E+01	20 MIN
RCFHC	12	N/A	--	N/A	--	1.8E-08	87	N/A	--	N/A	--	1.6E-08	100	N/A	--	N/A	--	2.8E+03	--	3.5E+02	5.3E+01	20 MIN
RCPVC	12	N/A	--	N/A	--	1.8E-08	87	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73	1.4E+03	--	1.8E+02	1.4E+01	20 MIN

See notes at end of table.

OFFSITE TRANSPORTATION - REGIONAL DISPOSAL OPTION

Accident Frequencies and Range Factors / Agent Available and Released

SCEN-ARIO	NO	ANAD FREQ.	RANGE FACTOR	AFG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
RCLGC	12	N/A	--	N/A	--	1.8E-08	87	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73	1.7E+03	--	2.2E+02	6.5E+01	20 MIN
RLBVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73	1.7E+03	--	2.2E+02	1.6E+01	20 MIN
RCRGC	12	N/A	--	N/A	--	1.8E-08	86	N/A	--	3.4E-08	86	N/A	--	N/A	--	5.4E-08	86	1.3E+03	--	1.6E+02	4.8E+01	20 MIN
RCRVC	12	N/A	--	N/A	--	1.8E-08	86	N/A	--	3.4E-08	86	N/A	--	N/A	--	5.4E-08	86	1.2E+03	--	1.5E+02	1.1E+01	20 MIN
RCEGF	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	86	5.3E+03	--	--	2.6E+02	2 HRS
RCFGF	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCHHF	13	N/A	--	1.2E-08	73	N/A	--	N/A	--	3.3E-08	63	N/A	--	N/A	--	1.6E-08	86	6.8E+03	--	--	1.7E+02	2 HRS
RCKVF	13	N/A	--	N/A	--	N/A	--	1.9E-08	64	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	--	--	9.0E+01	2 HRS
RCSVF	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	86	2.7E+03	--	--	3.4E+01	2 HRS
RCBGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76	5.3E+03	--	--	5.5E+00	6 HR
RCDHC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	91	N/A	--	N/A	--	2.3E+03	--	--	2.5E-01	6 HR
RCDGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	--	--	--	--
RCCHC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	91	N/A	--	N/A	--	1.8E+03	--	--	2.5E-01	6 HR
RCKGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCHHC	14	N/A	--	5.4E-08	74	N/A	--	N/A	--	6.1E-08	108	N/A	--	N/A	--	1.9E-10	76	6.8E+03	--	--	2.5E-01	6 HR
RCKVC	14	N/A	--	N/A	--	N/A	--	6.1E-08	87	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	--	--	2.1E-03	6 HR
RCMVC	14	N/A	--	N/A	--	N/A	--	N/A	--	6.1E-08	108	N/A	--	N/A	--	1.9E-10	76	2.3E+03	--	--	2.1E-03	6 HR
RCPGC	14	N/A	--	N/A	--	N/A		N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76	1.6E+03	--	--	5.5E+00	6 HR
RCPHC	14	N/A	--	N/A	--	6.1E-08	85	N/A	--	N/A	--	2.2E-10	91	N/A	--	N/A	--	2.8E+03	--	--	2.5E-01	6 HR
RCPVC	14	N/A	--	N/A	--	6.1E-08	85	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76	1.4E+03	--	--	2.1E-03	6 HR
RCQGC	14	N/A	--	N/A	--	6.1E-08	65	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76	1.7E+03	--	--	5.5E+00	6 HR
RCQVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76	1.7E+03	--	--	2.1E-03	6 HR
RCRGC	14	N/A	--	N/A	--	6.1E-08	85	N/A	--	6.1E-08	25	N/A	--	N/A	--	1.9E-10	76	1.3E+03	--	--	5.5E+00	6 HR
RCRVC	14	N/A	--	N/A	--	6.1E-08	85	N/A	--	6.1E-08	25	N/A	--	N/A	--	1.9E-10	76	1.2E+03	--	--	2.1E-03	6 HR
RCSVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76	2.7E+03	--	--	2.1E-03	6 HR
RCDHC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-09	83	N/A	--	N/A	--	2.3E+03	3.0E+01	6.0E+00	--	6 HRS
RCEEC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	--	--	--	--
RCCFC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-09	83	N/A	--	N/A	--	1.8E+03	1.6E+01	3.2E+00	--	6 HRS
RCMVC	15	N/A	--	N/A	--	N/A	--	N/A	--	1.0E-08	67	N/A	--	N/A	--	1.3E-08	117	2.3E+03	1.1E+03	3.2E+01	--	6 HRS

See notes at end of table.

Page 5 Date 20-Aug-87

OFFSITE TRANSPORTATION - REGIONAL DISPOSAL OPTION

Accident Frequencies and Range Factors

Agent Available and Released

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
RCFGC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117	1.6E+03	3.2E+01	6.5E+00	--	6 HRS
RCPHC	15	N/A	--	N/A	--	6.1E-09	71	N/A	--	N/A	--	4.1E-09	83	N/A	--	N/A	--	2.8E+03	5.8E+01	1.2E+01	--	6 HRS
RCFVC	15	N/A	--	N/A	--	6.1E-09	71	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117	1.4E+03	3.0E+01	6.0E+00	--	6 HRS
RCQGC	15	N/A	--	N/A	--	6.1E-09	71	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117	1.7E+03	7.3E+01	1.5E+01	--	6 HRS
RCQVC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117	1.7E+03	7.3E+01	1.5E+01	--	6 HRS
RCFGC	15	N/A	--	N/A	--	6.1E-09	71	N/A	--	1.0E-08	67	N/A	--	N/A	--	1.3E-08	117	1.3E+03	6.2E+02	1.1E+01	--	6 HRS
RCRVC	15	N/A	--	N/A	--	6.1E-09	71	N/A	--	1.0E-08	67	N/A	--	N/A	--	1.3E-08	117	1.2E+03	5.0E+01	1.0E+01	--	6 HRS

NOTES: 1. Scenarios 1-5 are per train mile; scenarios 6-15 are per exposure year.

2. Duration time shown for scenarios with agent releases due to detonations and spills is for spill only. Duration time for detonation is instantaneous.

Page 1 Date 20-Aug-87

OFFSITE TRANSPORTATION - NATIONAL DISPOSAL OPTION

Accident Frequencies and Range Factors | Agent Available and Released

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	AFG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
RCBGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	5.3E+03	2.2E+02	--	--	6 HRS
RCDHS	3	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	2.3E+03	6.0E+00	--	--	6 HRS
RCCGS	3	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	1.6E+00	--	--	6 HRS
RCCHS	3	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	1.8E+03	3.2E+00	--	--	6 HRS
RCKGS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCKHS	3	3.2E-09	10	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	6.8E+03	1.7E+03	--	--	6 HRS
RCKVS	3	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	1.8E+03	--	--	6 HRS
RCMVS	3	3.2E-09	10	N/A	--	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	2.3E+03	1.0E+01	--	--	6 HRS
RCPGS	3	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	1.6E+03	6.5E+00	--	--	6 HRS
RCPHS	3	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	N/A	--	N/A	--	2.8E+03	1.2E+01	--	--	6 HRS
RCPVS	3	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	1.4E+03	6.0E+00	--	--	6 HRS
RCQGS	3	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	1.7E+03	1.5E+01	--	--	6 HRS
RCQVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	1.7E+03	1.5E+01	--	--	6 HRS
RCRGS	3	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	1.3E+03	1.1E+01	--	--	6 HRS
RCRVS	3	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	3.2E-09	10	N/A	--	N/A	--	3.2E-09	10	1.2E+03	1.0E+01	--	--	6 HRS
RCSVS	3	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.2E-09	10	2.7E+03	1.4E+03	--	--	6 HRS
RCDHC	4	4.4E-10	23	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	23	N/A	--	N/A	--	2.3E+03	--	2.9E+02	4.3E+01	20 min
RCCGC	4	4.4E-10	23	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	--	1.2E+02	3.5E+01	20 min
RCCHC	4	4.4E-10	23	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	23	N/A	--	N/A	--	1.8E+03	--	2.3E+02	3.5E+01	20 min
RCMVC	4	4.4E-10	21	N/A	--	N/A	--	N/A	--	4.4E-10	21	N/A	--	N/A	--	4.4E-10	21	2.3E+03	--	2.8E+02	2.1E+01	20 min
RCPGC	4	4.4E-10	27	N/A	--	N/A		N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27	1.6E+03	--	2.0E+02	5.3E+01	20 min
RCPHC	4	4.4E-10	27	N/A	--	4.4E-10	27	N/A	--	N/A	--	4.4E-10	27	N/A	--	N/A	--	2.8E+03	--	3.5E+02	5.3E+01	20 min
RCPVC	4	4.4E-10	27	N/A	--	4.4E-10	27	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27	1.4E+03	--	1.8E+02	1.4E+01	20 min
RCQGC	4	4.4E-10	27	N/A	--	4.4E-10	27	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27	1.7E+03	--	2.2E+02	6.5E+01	20 min
RCQVC	4	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.4E-10	27	1.7E+03	--	2.2E+02	1.6E+01	20 min
RCRGC	4	4.5E-10	21	N/A	--	4.5E-10	21	N/A	--	4.5E-10	21	N/A	--	N/A	--	4.5E-10	21	1.3E+03	--	1.6E+02	4.8E+01	20 min
RCRVC	4	4.5E-10	21	N/A	--	4.5E-10	21	N/A	--	4.5E-10	21	N/A	--	N/A	--	4.5E-10	21	1.2E+03	--	1.5E+02	1.1E+01	20 min
RCBGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-10	47	5.3E+03	--	--	2.6E+02	2 HRS
RCKGF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCKHF	5	3.5E-10	47	3.5E-10	47	N/A	--	N/A	--	3.5E-10	47	N/A	--	N/A	--	3.5E-10	47	6.8E+03	--	--	1.7E+02	2 HRS

See notes at end of table.

OFFSITE TRANSPORTATION - NATIONAL DISPOSAL OPTION

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
		Accident Frequencies and Range Factors																Agent Available and Released				
RCKVF	5	N/A	--	N/A	--	N/A	--	3.5E-10	47	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	--	--	9.0E+01	2 HRS
RCSVF	5	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	3.5E-10	47	2.7E+03	--	--	3.4E+01	2 HRS
RCBGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	5.3E+03	9.0E+03	--	--	6 HRS
RCDHC	6	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	2.3E+03	3.2E+03	6.9E+02	--	6 HRS
RCCGC	6	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	1.3E+03	2.8E+02	--	6 HRS
RCCHC	6	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.8E+03	2.6E+03	5.5E+02	--	6 HRS
RCKGS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCKHS	6	1.7E-11	20	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	6.8E+03	1.2E+04	--	--	6 HRS
RCKVS	6	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	1.2E+04	--	--	6 HRS
RCMVC	6	1.7E-11	20	N/A	--	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	2.3E+03	3.2E+03	6.8E+02	--	6 HRS
RCPGC	6	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	1.6E+03	2.2E+03	4.7E+02	--	6 HRS
RCPHC	6	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	N/A	--	N/A	--	2.8E+03	3.9E+03	8.4E+02	--	6 HRS
RCFVC	6	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	1.4E+03	2.0E+03	4.3E+02	--	6 HRS
RCQGC	6	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	1.7E+03	2.4E+03	5.2E+02	--	6 HRS
RCQVC	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	1.7E+03	2.4E+03	5.2E+02	--	6 HRS
RCRGC	6	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	1.3E+03	1.8E+03	3.9E+02	--	6 HRS
RCRVC	6	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	1.7E-11	20	N/A	--	N/A	--	1.7E-11	20	1.2E+03	1.7E+03	3.6E+02	--	6 HRS
RCSVS	6	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.7E-11	20	2.7E+03	4.6E+03	--	--	6 HRS
RCBGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	5.3E+03	--	--	1.1E+03	1 HR
RCDHC	7	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	2.3E+03	--	1.2E+03	1.7E+02	20 MIN
RCCGC	7	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	--	4.6E+02	1.4E+02	20 MIN
RCCHC	7	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.8E+03	--	9.2E+02	1.4E+02	20 MIN
RCKGF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCKHF	7	1.4E-11	20	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	6.8E+03	--	--	6.8E+02	1 HR
RCKVF	7	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	--	--	3.6E+02	1 HR
RCMVC	7	1.4E-11	20	N/A	--	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	2.3E+03	--	1.1E+03	8.5E+01	20 MIN
RCPGC	7	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	1.6E+03	--	7.8E+02	2.3E+02	20 MIN
RCPHC	7	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	N/A	--	N/A	--	2.8E+03	--	1.4E+03	2.1E+02	20 MIN
RCFVC	7	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	1.4E+03	--	7.2E+02	5.4E+01	20 MIN
RCQGC	7	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	1.7E+03	--	8.7E+02	2.6E+02	20 MIN

See notes at end of table.

OFFSITE TRANSPORTATION - NATIONAL DISPOSAL OPTION

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
RCGVC	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	1.7E+03	--	8.7E+02	6.5E+01	20 MIN
RCRGC	7	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	1.3E+03	--	6.4E+02	1.9E+02	20 MIN
RCFVC	7	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	1.4E-11	20	N/A	--	N/A	--	1.4E-11	20	1.2E+03	--	6.0E+02	4.5E+01	20 MIN
RCSVF	7	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.4E-11	20	2.7E+03	--	--	1.4E+02	1 HR
RCBGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37	5.3E+03	2.2E+02	--	--	6 HRS
RCDHS	11	1.4E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-07	37	N/A	--	N/A	--	2.3E+03	6.0E+00	--	--	6 HRS
RCCGS	11	1.4E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	1.6E+00	--	--	6 HRS
RCCHS	11	1.4E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	1.5E-07	37	N/A	--	N/A	--	1.8E+03	3.2E+00	--	--	6 HRS
RCFGS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCFHS	11	1.4E-07	37	1.1E-07	37	N/A	--	N/A	--	1.6E-07	37	N/A	--	N/A	--	4.8E-07	37	6.8E+03	1.7E+03	--	--	6 HRS
RCFVS	11	N/A	--	N/A	--	N/A	--	1.3E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	1.8E+03	--	--	6 HRS
RCMVS	11	1.4E-07	37	N/A	--	N/A	--	N/A	--	1.6E-07	37	N/A	--	N/A	--	4.8E-07	37	2.3E+03	1.0E+01	--	--	6 HRS
RCFGS	11	1.4E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37	1.6E+03	6.5E+00	--	--	6 HRS
RCFHS	11	1.4E-07	37	N/A	--	3.0E-07	37	N/A	--	N/A	--	1.5E-07	37	N/A	--	N/A	--	2.6E+03	1.2E+01	--	--	6 HRS
RCFVS	11	1.4E-07	37	N/A	--	3.0E-07	37	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37	1.4E+03	6.0E+00	--	--	6 HRS
RCQGS	11	1.4E-07	37	N/A	--	3.0E-07	37	N/A	--	N/A	--	N/A	-	N/A	--	4.8E-07	37	1.7E+03	1.5E+01	--	--	6 HRS
RCQVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37	1.7E+03	1.5E+01	--	--	6 HRS
RCRGS	11	1.4E-07	37	N/A	--	3.0E-07	37	N/A	--	1.6E-07	37	N/A	--	N/A	--	4.8E-07	37	1.3E+03	1.1E+01	--	--	6 HRS
RCFVS	11	1.4E-07	37	N/A	--	3.0E-07	37	N/A	--	1.6E-07	37	N/A	--	N/A	--	4.8E-07	37	1.2E+03	1.0E+01	--	--	6 HRS
RCSVS	11	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	4.8E-07	37	2.7E+03	1.4E+03	--	--	6 HRS
RCDHC	12	1.6E-08	96	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	10	N/A	--	N/A	--	2.3E+03	--	2.9E+02	4.3E+01	20 MIN
RCCGC	12	1.6E-08	96	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	--	1.2E+02	3.5E+01	20 MIN
RCCHC	12	1.6E-06	96	N/A	--	N/A	--	N/A	--	N/A	--	1.6E-08	10	N/A	--	N/A	--	1.8E+03	--	2.3E+02	3.5E+01	20 MIN
RCMVC	12	1.6E-06	105	N/A	--	N/A	--	N/A	--	1.7E-08	61	N/A	--	N/A	--	5.3E-08	71	2.3E+03	--	2.8E+02	2.1E+01	20 MIN
RCFGC	12	1.5E-08	100	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73	1.6E+03	--	2.0E+02	5.8E+01	20 MIN
RCFHC	12	1.5E-08	100	N/A	--	3.2E-08	105	N/A	--	N/A	--	1.6E-08	100	N/A	--	N/A	--	2.8E+03	--	3.5E+02	5.3E+01	20 MIN
RCFVC	12	1.5E-08	100	N/A	--	3.2E-08	105	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73	1.4E+03	--	1.8E+02	1.4E+01	20 MIN
RCQGC	12	1.5E-08	100	N/A	--	3.2E-08	105	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73	1.7E+03	--	2.2E+02	6.5E+01	20 MIN
RCQVC	12	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	73	1.7E+03	--	2.2E+02	1.6E+01	20 MIN
RCRGC	12	1.6E-08	86	N/A	--	3.3E-08	86	N/A	--	1.7E-08	86	N/A	--	N/A	--	5.4E-08	86	1.3E+03	--	1.6E+02	4.8E+01	20 MIN

See notes at end of table.

OFFSITE TRANSPORTATION - NATIONAL DISPOSAL OPTION

Accident Frequencies and Range Factors / Agent Available and Released

SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
RCRVC	12	1.6E-08	86	N/A	--	3.3E-08	86	N/A	--	1.7E-08	86	N/A	--	N/A	--	5.4E-08	86	1.2E+03	--	1.5E+02	1.1E+01	20 MIN
RCBGF	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	89	5.3E+03	--	--	2.6E+02	2 HRS
RCKGF	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCKHF	13	1.5E-08	107	1.2E-08	118	N/A	--	N/A	--	1.7E-08	82	N/A	--	N/A	--	5.1E-12	89	6.8E+03	--	--	1.7E+02	2 HRS
RCKVF	13	N/A	--	N/A	--	N/A	--	1.4E-08	69	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	--	--	9.0E+01	2 HRS
RCSVF	13	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	5.2E-08	89	2.7E+03	--	--	3.4E+01	2 HRS
RCBGS	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76	5.3E+03	--	--	5.5E+00	6 HRS
RCDHC	14	4.5E-08	87	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	91	N/A	--	N/A	--	2.3E+03	--	--	2.5E-01	6 HRS
RCCGC	14	4.5E-08	87	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	--	--	3.2E+00	6 HRS
RCCHC	14	4.5E-08	87	N/A	--	N/A	--	N/A	--	N/A	--	2.2E-10	91	N/A	--	N/A	--	1.8E+03	--	--	2.5E-01	6 HRS
RCKGC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	6.0E+03	--	--	--	--
RCKHC	14	4.5E-08	87	4.0E-08	23	N/A	--	N/A	--	4.2E-08	95	N/A	--	N/A	--	1.9E-10	76	6.8E+03	--	--	2.5E-01	6 HRS
RCKVC	14	N/A	--	N/A	--	N/A	--	3.9E-08	120	N/A	--	N/A	--	N/A	--	N/A	--	7.2E+03	--	--	2.1E-03	6 HRS
RCMVC	14	4.5E-08	87	N/A	--	N/A	--	N/A	--	4.2E-08	95	N/A	--	N/A	--	1.9E-10	76	2.3E+03	--	--	2.1E-03	6 HRS
RCFGC	14	4.5E-08	87	N/A	--	N/A		N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76	1.6E+03	--	--	5.5E+00	6 HRS
RCPHC	14	4.5E-08	87	N/A	--	4.3E-08	80	N/A	--	N/A	--	2.2E-10	91	N/A	--	N/A	--	2.8E+03	--	--	2.5E-01	6 HRS
RCPVC	14	4.5E-08	87	N/A	--	4.3E-08	80	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76	1.4E+03	--	--	2.1E-03	6 HRS
RCOGC	14	4.5E-08	87	N/A	--	4.3E-08	80	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76	1.7E+03	--	--	5.5E+00	6 HRS
RCQVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76	1.7E+03	--	--	2.1E-03	6 HRS
RCRGC	14	4.5E-08	87	N/A	--	4.3E-08	80	N/A	--	4.2E-08	95	N/A	--	N/A	--	1.9E-10	76	1.3E+03	--	--	5.5E+00	6 HRS
RCRVC	14	4.5E-08	87	N/A	--	4.3E-08	80	N/A	--	4.2E-08	95	N/A	--	N/A	--	1.9E-10	76	1.2E+03	--	--	2.1E-03	6 HRS
RCSVC	14	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.9E-10	76	2.7E+03	--	--	2.1E-03	6 HRS
RCDHC	15	5.2E-09	73	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-09	83	N/A	--	N/A	--	2.3E+03	3.0E+01	6.0E+00	--	6 HRS
RCCGC	15	5.2E-09	73	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	9.2E+02	8.0E+00	1.6E+00	--	6 HRS
RCCHC	15	5.2E-09	73	N/A	--	N/A	--	N/A	--	N/A	--	4.1E-09	83	N/A	--	N/A	--	1.8E+03	1.6E+01	3.2E+00	--	6 HRS
RCMVC	15	5.2E-09	73	N/A	--	N/A	--	N/A	--	5.5E-09	91	N/A	--	N/A	--	1.3E-08	117	2.3E+03	1.1E+03	3.2E+01	--	6 HRS
RCFGC	15	5.2E-09	73	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117	1.6E+03	3.2E+01	6.5E+00	--	6 HRS
RCPHC	15	5.2E-09	73	N/A	--	9.4E-09	82	N/A	--	N/A	--	4.1E-09	83	N/A	--	N/A	--	2.8E+03	5.8E+01	1.2E+01	--	6 HRS
RCPVC	15	5.2E-09	73	N/A	--	9.4E-09	82	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117	1.4E+03	3.0E+01	6.0E+00	--	6 HRS
RCOGC	15	5.2E-09	73	N/A	--	9.4E-09	82	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117	1.7E+03	7.3E+01	1.5E+01	--	6 HRS

See notes at end of table.

OFFSITE TRANSPORTATION - NATIONAL DISPOSAL OPTION

		Accident Frequencies and Range Factors																Agent Available and Released				
SCEN-ARIO	NO.	ANAD FREQ.	RANGE FACTOR	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	NAAP FREQ.	RANGE FACTOR	PBA FREQ.	RANGE FACTOR	PUDA FREQ.	RANGE FACTOR	TEAD FREQ.	RANGE FACTOR	UMDA FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
RCOVC	15	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	N/A	--	1.3E-08	117	1.7E+03	7.3E+01	1.5E+01	--	6 HRS
RCRGC	15	5.2E-09	73	N/A	--	9.4E-09	82	N/A	--	5.5E-09	91	N/A	--	N/A	--	1.3E-08	117	1.3E+03	6.2E+02	1.1E+01	--	6 HRS
RCRVC	15	5.2E-09	73	N/A	--	9.4E-09	82	N/A	--	5.5E-09	91	N/A	--	N/A	--	1.3E-08	117	1.2E+03	5.0E+01	1.0E+01	--	6 HRS

NOTES: 1. Scenarios 1-5 are per train mile; scenarios 6-15 are per exposure year.

2. Duration time shown for scenarios with agent releases due to detonations and spills is for spill only. Duration time for detonation is instantaneous.

File: OFSITREG.WK1 Page 1 Date 27-Jul-87

OFFSITE TRANSPORTATION - BARGE

Agent Available and Released

SCENARIO	NO.	FREQUENCY PER TRIP	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
BIKHS	2	3.09E-06	10	95200	--	--	175.4	24HR
BIKHF	4	2.00E-06	10	95200	--	--	170.0	1HR
BIKHS	6	3.00E-09	10	95200	--	--	87.7	24HR
BIKHF	8	3.00E-09	10	95200	--	--	17.0	1HR
BIKHS	10	3.00E-09	10	95200	--	--	--	--
BIKHS	12	3.00E-09	10	95200	--	--	--	--
BIKHS	14	3.00E-09	10	95200	--	--	--	--
BIKHS	16	3.00E-09	10	95200	--	--	--	--
BIKHS	19	3.53E-06	10	95200	--	--	--	--
BIKHS	20	3.53E-06	10	95200	--	--	--	--
BIKHS	21	1.64E-06	10	95200	--	--	--	--
BIKHS	22	3.00E-09	10	95200	--	--	--	--
BIKHS	23	2.06E-07	10	95200	--	--	8500.0	1HR

File: OFSITREG.WK1 Page 1   Date 27-Jul-87

OFFSITE TRANSPORTATION - SHIP INLAND

Agent Available and Released

SCENARIO	NO.	FREQUENCY PER TRIP	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
LIKHS	1	2.67E-06	10	3.81E+06	--	--	1.23E+03	24HR
LIKHS	2	1.41E-07	10	3.81E+06	--	--	1.23E+03	24HR
LIKHC	3	6.68E-07	10	3.81E+06	--	--	1.19E+03	1HR
LIKHF	4	3.53E-08	10	3.81E+06	--	--	1.19E+03	1HR
LIKHS	5	1.19E-07	10	3.81E+06	--	--	7.02E+02	24HR
LIKHS	6	3.00E-09	10	3.81E+06	--	--	7.02E+02	24HR
LIKHF	7	2.98E-08	10	3.81E+06	--	--	6.80E+02	1HR
LIKHS	8	3.00E-09	10	3.81E+06	--	--	6.80E+02	1HR
LIKHS	9	1.77E-06	10	3.81E+06	--	--	--	--
LIKHS	10	1.43E-07	10	3.81E+06	--	--	--	--
LIKHS	11	3.61E-08	10	3.81E+06	--	--	--	--
LIKHS	12	3.00E-09	10	3.81E+06	--	--	--	--
LIKHS	13	3.00E-09	10	3.81E+06	--	--	--	--
LIKHS	14	3.00E-09	10	3.81E+06	--	--	--	--
LIKHS	15	3.00E-09	10	3.81E+06	--	--	--	--
LIKHS	16	3.00E-09	10	3.81E+06	--	--	--	--
LIKHF	17	3.00E-09	10	3.81E+06	--	--	8.50E+01	1HR
LIKHF	18	3.00E-09	10	3.81E+06	--	--	8.50E+01	1HR
LIKHS	19	5.84E-07	10	3.81E+06	--	--	--	--
LIKHS	20	3.00E-09	10	3.81E+06	--	--	--	--
LIKHS	21	1.61E-06	10	3.81E+06	--	--	--	--
LIKHS	22	3.00E-09	10	3.81E+06	--	--	--	--
LIKHS	23	2.70E-09	10	3.81E+06	--	--	6.05E+04	1HR

File: OFSITREG.WK1 Page 1 Date 27-Jul-87

OFFSITE TRANSPORTATION - SHIP COASTAL

Agent Available and Released

SCENARIO	NO.	FREQUENCY PER TRIP	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
LCKHS	1	1.24E-06	10	3.81E+06	--	--	1.23E+03	24HR
LCKHS	2	6.51E-08	10	3.81E+06	--	--	1.23E+03	24HR
LCKHF	3	3.09E-07	10	3.81E+06	--	--	1.19E+03	1HR
LCKHF	4	1.63E-08	10	3.81E+06	--	--	1.19E+03	1HR
LCKHS	5	7.97E-08	10	3.81E+06	--	--	7.02E+02	24HR
LCKHS	6	3.00E-09	10	3.81E+06	--	--	7.02E+02	24HR
LCKHF	7	1.99E-08	10	3.81E+06	--	--	6.80E+02	1HR
LCKHF	8	3.00E-09	10	3.81E+06	--	--	6.80E+02	1HR
LCKHS	9	5.13E-07	10	3.81E+06	--	--	--	--
LCKHS	10	4.16E-08	10	3.81E+06	--	--	--	--
LCKHS	11	1.05E-08	10	3.81E+06	--	--	--	--
LCKHS	12	3.00E-09	10	3.81E+06	--	--	--	--
LCKHS	13	3.00E-09	10	3.81E+06	--	--	--	--
LCKHS	14	3.00E-09	10	3.81E+06	--	--	--	--
LCKHS	15	3.00E-09	10	3.81E+06	--	--	--	--
LCKHS	16	3.00E-09	10	3.81E+06	--	--	--	--
LCKHF	17	3.00E-09	10	3.81E+06	--	--	8.50E+01	1HR
LCKHF	18	3.00E-09	10	3.81E+06	--	--	8.50E+01	1HR
LCKHS	19	2.70E-07	10	3.81E+06	--	--	--	--
LCKHS	20	3.00E-09	10	3.81E+06	--	--	--	--
LCKHS	21	4.67E-07	10	3.81E+06	--	--	--	--
LCKHS	22	3.00E-09	10	3.81E+06	--	--	--	--
LCKHS	23	2.70E-09	10	3.81E+06	--	--	6.05E+04	1HR

File: OFSITREG.WK1 Page 1 Date 27-Jul-87

OFFSITE TRANSPORTATION - SHIP HIGH SEAS

Agent Available and Released

SCENARIO	NO.	FREQUENCY PER TRIP	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
LSKHS	1	2.79E-07	10	3.81E+06	--	--	1.23E+03	24HR
LSKHS	2	1.47E-08	10	3.81E+06	--	--	1.23E+03	24HR
LSKHF	3	6.98E-08	10	3.81E+06	--	--	1.19E+03	1HR
LSKHF	4	3.67E-09	10	3.81E+06	--	--	1.19E+03	1HR
LSKHS	5	3.67E-09	10	3.81E+06	--	--	7.02E+02	24HR
LSKHS	6	3.00E-09	10	3.81E+06	--	--	7.02E+02	24HR
LSKHF	7	1.56E-08	10	3.81E+06	--	--	6.80E+02	1HR
LSKHF	8	3.00E-09	10	3.81E+06	--	--	6.80E+02	1HR
LSKHS	9	4.33E-08	10	3.81E+06	--	--	--	--
LSKHS	10	3.51E-09	10	3.81E+06	--	--	--	--
LSKHS	11	3.00E-09	10	3.81E+06	--	--	--	--
LSKHS	12	3.00E-09	10	3.81E+06	--	--	--	--
LSKHS	13	3.00E-09	10	3.81E+06	--	--	--	--
LSKHS	14	3.00E-09	10	3.81E+06	--	--	--	--
LSKHS	15	3.00E-09	10	3.81E+06	--	--	--	--
LSKHS	16	3.00E-09	10	3.81E+06	--	--	--	--
LSKHF	17	3.00E-09	10	3.81E+06	--	--	8.50E+01	1HR
LSKHF	18	3.00E-09	10	3.81E+06	--	--	8.50E+01	1HR
LSKHS	19	6.10E-08	10	3.81E+06	--	--	--	--
LSKHS	20	3.94E-08	10	3.81E+06	--	--	--	--
LSKHS	21	3.00E-09	10	3.81E+06	--	--	--	--
LSKHS	22	3.00E-09	10	3.81E+06	--	--	--	--
LSKHS	23	2.70E-09	10	3.81E+06	--	--	6.05E+04	1HR

File: OFSITREG.WK1 Page 1 Date 20-Aug-87

OFFSITE TRANSPORTATION - AIR LEG FOR C141 AIRCRAFT

							Agent Available and Released			
SCENARIO	NO.	APS FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
ABKHS	1T	1.20E-08	11	N/A	--	3400	2.89E+03	--	--	24 HR
ABPHC	1T	N/A	--	1.20E-08	11	1498	1.05E+03	2.25E+02	--	24 HR
ABPVC	1T	N/A	--	1.20E-08	11	768	5.38E+02	1.15E+02	--	24 HR
ABQGC	1T	N/A	--	1.20E-08	11	1044	7.31E+02	1.57E+02	--	24 HR
ABQVC	1T	N/A	--	N/A	--	1044	7.31E+02	1.57E+02	--	24 HR
ABRGC	1T	N/A	--	1.20E-08	11	642	4.49E+02	9.60E+01	--	24 HR
ABRVC	1T	N/A	--	1.20E-08	11	600	4.20E+02	9.00E+01	--	24 HR
ABKHF	2T	9.90E-09	11	N/A	--	3400	--	--	1.7E+02	1 HR
ABPHC	2T	N/A	--	9.90E-09	11	1498	--	3.74E+02	5.6E+01	20 MIN
ABPVC	2T	N/A	--	9.90E-09	11	768	--	1.92E+02	1.4E+01	20 MIN
ABQGC	2T	N/A	--	9.90E-09	11	1044	--	2.61E+02	7.8E+01	20 MIN
ABQVC	2T	N/A	--	N/A	--	1044	--	2.61E+02	2.0E+01	20 MIN
ABRGC	2T	N/A	--	9.90E-09	11	642	--	1.60E+02	4.8E+01	20 MIN
ABRVC	2T	N/A	--	9.90E-09	11	600	--	1.50E+02	1.1E+01	20 MIN
ABKHF	3T	0.00E+00	--	N/A	--	3400	--	--	--	--
ABPHC	3T	N/A	--	0.00E+00	--	1498	--	--	--	--
ABPVC	3T	N/A	--	0.00E+00	--	768	--	--	--	--
ABQGC	3T	N/A	--	0.00E+00	--	1044	--	--	--	--
ABQVC	3T	N/A	--	N/A	--	1044	--	--	--	--
ABRGC	3T	N/A	--	0.00E+00	--	642	--	--	--	--
ABRVC	3T	N/A	--	0.00E+00	--	600	--	--	--	--
ABKHF	4T	1.20E-08	13	N/A	--	3400	--	0.00E+00	1.70E+02	--
ABPHC	4T	N/A	--	1.20E-08	13	1498	--	3.74E+02	5.60E+01	--
ABPVC	4T	N/A	--	1.20E-08	13	768	--	1.92E+02	1.40E+01	--
ABQGC	4T	N/A	--	1.20E-08	13	1044	--	2.61E+02	7.80E+01	--
ABQVC	4T	N/A	--	N/A	--	1044	--	2.61E+02	2.00E+01	--
ABRGC	4T	N/A	--	1.20E-08	13	642	--	1.60E+02	4.80E+01	--
ABRVC	4T	N/A	--	1.20E-08	13	600	--	1.50E+02	1.10E+01	--
ABKHF	5T	0.00E+00	--	N/A	--	3400	--	--	--	--
ABPHC	5T	N/A	--	2.61E-10	57	1498	5.80E+01	1.20E+01	--	24 HR
ABPVC	5T	N/A	--	2.61E-10	57	768	3.00E+01	6.00E+00	--	24 HR
ABQGC	5T	N/A	--	2.61E-10	57	1044	7.20E+01	1.40E+01	--	24 HR
ABQVC	5T	N/A	--	N/A	--	1044	7.20E+01	1.40E+01	--	24 HR
ABRGC	5T	N/A	--	1.88E-09	57	642	5.99E+02	4.30E+01	--	24 HR
ABRVC	5T	N/A	--	1.88E-09	57	600	5.60E+02	4.00E+01	--	24 HR
ABKHS	1F	4.70E-07	11	N/A	--	3400	2.89E+03	--	--	24 HR
ABPHC	1F	N/A	--	3.40E-07	11	1498	1.05E+03	2.25E+02	--	24 HR
ABPVC	1F	N/A	--	3.40E-07	11	768	5.38E+02	1.15E+02	--	24 HR
ABQGC	1F	N/A	--	3.40E-07	11	1044	7.31E+02	1.57E+02	--	24 HR
ABQVC	1F	N/A	--	N/A	--	1044	7.31E+02	1.57E+02	--	24 HR
ABRGC	1F	N/A	--	3.40E-07	11	642	4.49E+02	9.60E+01	--	24 HR
ABRVC	1F	N/A	--	3.40E-07	11	600	4.20E+02	9.00E+01	--	24 HR
ABKHF	2F	3.80E-07	11	N/A	--	3400	--	--	1.7E+02	1 HR
ABPHC	2F	N/A	--	2.80E-07	11	1498	--	3.74E+02	5.6E+01	20 MIN
ABPVC	2F	N/A	--	2.80E-07	11	768	--	1.92E+02	1.4E+01	20 MIN
ABQGC	2F	N/A	--	2.80E-07	11	1044	--	2.61E+02	7.8E+01	20 MIN
ABQVC	2F	N/A	--	N/A	--	1044	--	2.61E+02	2.0E+01	20 MIN
ABRGC	2F	N/A	--	2.80E-07	11	642	--	1.60E+02	4.8E+01	20 MIN

OFFSITE TRANSPORTATION - AIR LEG FOR C141 AIRCRAFT

SCENARIO	NO.	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
						Agent Available and Released				
ABRVC	2F	N/A	--	2.80E-07	11	600	--	1.50E+02	1.1E+01	20 MIN
ABKHF	3F	0.00E+00	--	N/A	--	3400	--	--	--	--
ABPHC	3F	N/A	--	0.00E+00	--	1498	--	--	--	--
ABPVC	3F	N/A	--	0.00E+00	--	768	--	--	--	--
ABQGC	3F	N/A	--	0.00E+00	--	1044	--	--	--	--
ABQVC	3F	N/A	--	N/A	--	1044	--	--	--	--
ABRGC	3F	N/A	--	0.00E+00	--	642	--	--	--	--
ABRVC	3F	N/A	--	0.00E+00	--	600	--	--	--	--
ABKHF	4F	3.60E-08	13	N/A	--	3400	--	0.00E+00	1.70E+02	--
ABPHC	4F	N/A	--	2.60E-08	13	1498	--	3.74E+02	5.60E+01	--
ABPVC	4F	N/A	--	2.60E-08	13	768	--	1.92E+02	1.40E+01	--
ABQGC	4F	N/A	--	2.60E-08	13	1044	--	2.61E+02	7.80E+01	--
ABQVC	4F	N/A	--	N/A	--	1044	--	2.61E+02	2.00E+01	--
ABRGC	4F	N/A	--	2.60E-08	13	642	--	1.60E+02	4.80E+01	--
ABRVC	4F	N/A	--	2.60E-08	13	600	--	1.50E+02	1.10E+01	--
ABKHF	5F	0.00E+00	--	N/A	--	3400	--	--	--	--
ABPHC	5F	N/A	--	5.40E-10	57	1498	5.80E+01	1.20E+01	--	24 HR
ABPVC	5F	N/A	--	5.40E-10	57	768	3.00E+01	6.00E+00	--	24 HR
ABQGC	5F	N/A	--	5.40E-10	57	1044	7.20E+01	1.40E+01	--	24 HR
ABQVC	5F	N/A	--	N/A	--	1044	7.20E+01	1.40E+01	--	24 HR
ABRGC	5F	N/A	--	3.88E-09	57	642	5.99E+02	4.30E+01	--	24 HR
ABRVC	5F	N/A	--	3.88E-09	57	600	5.60E+02	4.00E+01	--	24 HR
ABKHS	1L	7.00E-08	11	N/A	--	3400	2.89E+03	--	--	24 HR
ABPHC	1L	N/A	--	7.00E-08	11	1498	1.05E+03	2.25E+02	--	24 HR
ABPVC	1L	N/A	--	7.00E-08	11	768	5.38E+02	1.15E+02	--	24 HR
ABQGC	1L	N/A	--	7.00E-08	11	1044	7.31E+02	1.57E+02	--	24 HR
ABQVC	1L	N/A	--	N/A	--	1044	7.31E+02	1.57E+02	--	24 HR
ABRGC	1L	N/A	--	7.00E-08	11	642	4.49E+02	9.60E+01	--	24 HR
ABRVC	1L	N/A	--	7.00E-08	11	600	4.20E+02	9.00E+01	--	24 HR
ABKHF	2L	5.70E-08	11	N/A	--	3400	--	--	1.7E+02	1 HR
ABPHC	2L	N/A	--	5.70E-08	11	1498	--	3.74E+02	5.6E+01	20 MIN
ABPVC	2L	N/A	--	5.70E-08	11	768	--	1.92E+02	1.4E+01	20 MIN
ABQGC	2L	N/A	--	5.70E-08	11	1044	--	2.61E+02	7.8E+01	20 MIN
ABQVC	2L	N/A	--	N/A	--	1044	--	2.61E+02	2.0E+01	20 MIN
ABRGC	2L	N/A	--	5.70E-08	11	642	--	1.60E+02	4.8E+01	20 MIN
ABRVC	2L	N/A	--	5.70E-08	11	600	--	1.50E+02	1.1E+01	20 MIN
ABKHF	3L	0.00E+00	--	N/A	--	3400	--	--	--	--
ABPHC	3L	N/A	--	0.00E+00	--	1498	--	--	--	--
ABPVC	3L	N/A	--	0.00E+00	--	768	--	--	--	--
ABQGC	3L	N/A	--	0.00E+00	--	1044	--	--	--	--
ABQVC	3L	N/A	--	N/A	--	1044	--	--	--	--
ABRGC	3L	N/A	--	0.00E+00	--	642	--	--	--	--
ABRVC	3L	N/A	--	0.00E+00	--	600	--	--	--	--
ABKHF	4L	8.40E-08	13	N/A	--	3400	--	0.00E+00	1.70E+02	--
ABPHC	4L	N/A	--	8.40E-08	13	1498	--	3.74E+02	5.60E+01	--
ABPVC	4L	N/A	--	8.40E-08	13	768	--	1.92E+02	1.40E+01	--
ABQGC	4L	N/A	--	8.40E-08	13	1044	--	2.61E+02	7.80E+01	--
ABQVC	4L	N/A	--	N/A	--	1044	--	2.61E+02	2.00E+01	--

OFFSITE TRANSPORTATION - AIR LEG FOR C141 AIRCRAFT

						Agent Available and Released				
SCENARIO	NO.	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
ABRGC	4L	N/A	--	8.40E-08	13	642	--	1.60E+02	4.80E+01	--
ABRVC	4L	N/A	--	8.40E-08	13	600	--	1.50E+02	1.10E+01	--
ABKHF	5L	0.00E+00	--	N/A	--	3400	--	--	--	--
ABPHC	5L	N/A	--	1.80E-09	57	1498	5.80E+01	1.20E+01	--	24 HR
ABPVC	5L	N/A	--	1.80E-09	57	768	3.00E+01	6.00E+00	--	24 HR
ABQGC	5L	N/A	--	1.80E-09	57	1044	7.20E+01	1.40E+01	--	24 HR
ABQVC	5L	N/A	--	N/A	--	1044	7.20E+01	1.40E+01	--	24 HR
ABRGC	5L	N/A	--	1.29E-08	57	642	5.99E+02	4.30E+01	--	24 HR
ABRVC	5L	N/A	--	1.29E-08	57	600	5.60E+02	4.00E+01	--	24 HR

OFFSITE TRANSPORTATION - AIR LEG FOR C5A AIRCRAFT

Agent Available and Released

SCENARIO	NO.	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
AAKHS	1T	1.00E-07	11	N/A	--	13600	1.16E+04	--	--	24 HR
AAPHC	1T	N/A	--	1.00E-07	11	5990	4.19E+03	8.98E+02	--	24 HR
AAPVC	1T	N/A	--	1.00E-07	11	3072	2.15E+03	4.61E+02	--	24 HR
AAQGC	1T	N/A	--	1.00E-07	11	4176	2.92E+03	6.26E+02	--	24 HR
AAQVC	1T	N/A	--	N/A	--	4176	2.92E+03	6.26E+02	--	24 HR
AARGC	1T	N/A	--	1.00E-07	11	2568	1.80E+03	3.85E+02	--	24 HR
AARVC	1T	N/A	--	1.00E-07	11	2400	1.68E+03	3.60E+02	--	24 HR
AAKHF	2T	8.20E-08	11	N/A	--	13600	--	--	6.8E+02	1 HR
AAPHC	2T	N/A	--	8.20E-08	11	5990	--	1.50E+03	2.2E+02	20 MIN
AAPVC	2T	N/A	--	8.20E-08	11	3072	--	7.68E+02	5.8E+01	20 MIN
AAQGC	2T	N/A	--	8.20E-08	11	4176	--	1.04E+03	3.1E+02	20 MIN
AAQVC	2T	N/A	--	N/A	--	4176	--	1.04E+03	7.8E+01	20 MIN
AARGC	2T	N/A	--	8.20E-08	11	2568	--	6.42E+02	1.9E+02	20 MIN
AARVC	2T	N/A	--	8.20E-08	11	2400	--	6.00E+02	4.5E+01	20 MIN
AAKHF	3T	2.90E-08	12	N/A	--	13600	--	--	6.8E+02	1 HR
AAPHC	3T	N/A	--	2.90E-08	12	5990	--	1.50E+03	2.2E+02	20 MIN
AAPVC	3T	N/A	--	2.90E-08	12	3072	--	7.68E+02	5.8E+01	20 MIN
AAQGC	3T	N/A	--	2.90E-08	12	4176	--	1.04E+03	3.1E+02	20 MIN
AAQVC	3T	N/A	--	N/A	--	4176	--	1.04E+03	7.8E+01	20 MIN
AARGC	3T	N/A	--	2.90E-08	12	2568	--	6.42E+02	1.9E+02	20 MIN
AARVC	3T	N/A	--	2.90E-08	12	2400	--	6.00E+02	4.5E+01	20 MIN
AAKHF	4T	1.00E-07	13	N/A	--	13600	--	--	6.8E+02	1 HR
AAPHC	4T	N/A	--	1.00E-07	13	5990	--	1.50E+03	2.2E+02	20 MIN
AAPVC	4T	N/A	--	1.00E-07	13	3072	--	7.68E+02	5.8E+01	20 MIN
AAQGC	4T	N/A	--	1.00E-07	13	4176	--	1.04E+03	3.1E+02	20 MIN
AAQVC	4T	N/A	--	N/A	--	4176	--	1.04E+03	7.8E+01	20 MIN
AARGC	4T	N/A	--	1.00E-07	13	2568	--	6.42E+02	1.9E+02	20 MIN
AARVC	4T	N/A	--	1.00E-07	13	2400	--	6.00E+02	4.5E+01	20 MIN
AAKHF	5T	0.00E+00	--	N/A	--	3400	--	--	--	--
AAPHC	5T	N/A	--	2.10E-09	57	1498	5.80E+01	1.20E+01	--	24 HR
AAPVC	5T	N/A	--	2.10E-09	57	768	3.00E+01	6.00E+00	--	24 HR
AAQGC	5T	N/A	--	2.10E-09	57	1044	7.20E+01	1.40E+01	--	24 HR
AAQVC	5T	N/A	--	N/A	--	1044	7.20E+01	1.40E+01	--	24 HR
AARGC	5T	N/A	--	1.51E-08	57	642	5.99E+02	4.30E+01	--	24 HR
AARVC	5T	N/A	--	1.51E-08	57	600	5.60E+02	4.00E+01	--	24 HR
AAKHS	1F	4.00E-06	11	N/A	--	13600	1.16E+04	--	--	24 HR
AAPGC	1F	N/A	--	2.80E-06	11	3323	2.33E+03	4.99E+02	--	24 HR
AAPHC	1F	N/A	--	2.80E-06	11	5990	4.19E+03	8.99E+02	--	24 HR
AAPVC	1F	N/A	--	2.80E-06	11	3072	2.15E+03	4.61E+02	--	24 HR
AAQGC	1F	N/A	--	2.80E-06	11	4176	2.92E+03	6.26E+02	--	24 HR
AAQVC	1F	N/A	--	N/A	--	4176	2.92E+03	6.26E+02	--	24 HR
AARGC	1F	N/A	--	2.80E-06	11	2568	1.80E+03	3.85E+02	--	24 HR
AARVC	1F	N/A	--	2.80E-06	11	2400	1.68E+03	3.60E+02	--	24 HR
AAKHF	2F	3.20E-06	11	N/A	--	13600	--	--	6.8E+02	1 HR
AAPHC	2F	N/A	--	2.30E-06	11	5990	--	1.50E+03	2.2E+02	20 MIN
AAPVC	2F	N/A	--	2.30E-06	11	3072	--	7.68E+02	5.8E+01	20 MIN
AAQGC	2F	N/A	--	2.30E-06	11	4176	--	1.04E+03	3.1E+02	20 MIN
AAQVC	2F	N/A	--	N/A	--	4176	--	1.04E+03	7.8E+01	20 MIN

File: OFSITREG.WK1 Page 2 Date 20-Aug-87

OFFSITE TRANSPORTATION - AIR LEG FOR C5A AIRCRAFT

SCENARIO	NO.	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
						Agent Available and Released				
AARGC	2F	N/A	--	2.30E-06	11	2568	--	6.42E+02	1.9E+02	20 MIN
AARVC	2F	N/A	--	2.30E-06	11	2400	--	6.00E+02	4.5E+01	20 MIN
AAKHF	3F	0.00E+00	--	N/A	--	13600	--	--	--	--
AAPHC	3F	N/A	--	0.00E+00	12	5990	--	--	--	--
AAPVC	3F	N/A	--	0.00E+00	12	3072	--	--	--	--
AAQGC	3F	N/A	--	0.00E+00	12	4176	--	--	--	--
AAQVC	3F	N/A	--	N/A	--	4176	--	--	--	--
AARGC	3F	N/A	--	0.00E+00	12	2568	--	--	--	--
AARVC	3F	N/A	--	0.00E+00	12	2400	--	--	--	--
AAKHF	4F	3.00E-07	13	N/A	--	13600	--	--	6.8E+02	1 HR
AAPHC	4F	N/A	--	2.20E-07	13	5990	--	1.50E+03	2.2E+02	20 MIN
AAPVC	4F	N/A	--	2.20E-07	13	3072	--	7.68E+02	5.8E+01	20 MIN
AAQGC	4F	N/A	--	2.20E-07	13	4176	--	1.04E+03	3.1E+02	20 MIN
AAQVC	4F	N/A	--	N/A	--	4176	--	1.04E+03	7.8E+01	20 MIN
AARGC	4F	N/A	--	2.20E-07	13	2568	--	6.42E+02	1.9E+02	20 MIN
AARVC	4F	N/A	--	2.20E-07	13	2400	--	6.00E+02	4.5E+01	20 MIN
AAKHF	5F	0.00E+00	--	N/A	--	3400	--	--	--	--
AAPHC	5F	N/A	--	4.50E-09	57	1498	5.80E+01	1.20E+01	--	24 HR
AAPVC	5F	N/A	--	4.50E-09	57	768	3.00E+01	6.00E+00	--	24 HR
AAQGC	5F	N/A	--	4.50E-09	57	1044	7.20E+01	1.40E+01	--	24 HR
AAQVC	5F	N/A	--	N/A	--	1044	7.20E+01	1.40E+01	--	24 HR
AARGC	5F	N/A	--	3.23E-08	57	642	5.99E+02	4.30E+01	--	24 HR
AARVC	5F	N/A	--	3.23E-08	57	600	5.60E+02	4.00E+01	--	24 HR
AAKHS	1L	5.60E-07	11	N/A	--	13600	1.16E+04	--	--	24 HR
AAPHC	1L	N/A	--	5.60E-07	11	5990	4.19E+03	8.99E+02	--	24 HR
AAPVC	1L	N/A	--	5.60E-07	11	3072	2.15E+03	4.61E+02	--	24 HR
AAQGC	1L	N/A	--	5.60E-07	11	4176	2.92E+03	6.26E+02	--	24 HR
AAQVC	1L	N/A	--	N/A	--	4176	2.92E+03	6.26E+02	--	24 HR
AARGC	1L	N/A	--	5.60E-07	11	2568	1.80E+03	3.85E+02	--	24 HR
AARVC	1L	N/A	--	5.60E-07	11	2400	1.68E+03	3.60E+02	--	24 HR
AAKHF	2L	4.60E-07	11	N/A	--	13600	--	--	6.8E+02	1 HR
AAPHC	2L	N/A	--	4.60E-07	11	5990	--	1.50E+03	2.2E+02	20 MIN
AAPVC	2L	N/A	--	4.60E-07	11	3072	--	7.68E+02	5.8E+01	20 MIN
AAQGC	2L	N/A	--	4.60E-07	11	4176	--	1.04E+03	3.1E+02	20 MIN
AAQVC	2L	N/A	--	N/A	--	4176	--	1.04E+03	7.8E+01	20 MIN
AARGC	2L	N/A	--	4.60E-07	11	2568	--	6.42E+02	1.9E+02	20 MIN
AARVC	2L	N/A	--	4.60E-07	11	2400	--	6.00E+02	4.5E+01	20 MIN
AAKHF	3L	0.00E+00	--	N/A	--	13600	--	--	--	--
AAPHC	3L	N/A	--	0.00E+00	12	5990	--	--	--	--
AAPVC	3L	N/A	--	0.00E+00	12	3072	--	--	--	--
AAQGC	3L	N/A	--	0.00E+00	12	4176	--	--	--	--
AAQVC	3L	N/A	--	N/A	--	4176	--	--	--	--
AARGC	3L	N/A	--	0.00E+00	12	2568	--	--	--	--
AARVC	3L	N/A	--	0.00E+00	12	2400	--	--	--	--
AAKHF	4L	6.70E-07	13	N/A	--	13600	--	--	6.8E+02	1 HR
AAPHC	4L	N/A	--	6.70E-07	13	5990	--	1.50E+03	2.2E+02	20 MIN
AAPVC	4L	N/A	--	6.70E-07	13	3072	--	7.68E+02	5.8E+01	20 MIN
AAQGC	4L	N/A	--	6.70E-07	13	4176	--	1.04E+03	3.1E+02	20 MIN

File: OFSITREG.WK1 Page 3 Date 20-Aug-87

OFFSITE TRANSPORTATION - AIR LEG FOR C5A AIRCRAFT

SCENARIO	NO.	APG FREQ.	RANGE FACTOR	LBAD FREQ.	RANGE FACTOR	AGENT AVAILABLE	LBS. SPILLED	LBS. DETONATED	LBS. EMITTED	DURATION TIME
						Agent Available and Released				
AAQVC	4L	N/A	--	N/A	--	4176	--	1.04E+03	7.8E+01	20 MIN
AARGC	4L	N/A	--	6.70E-07	13	2568	--	6.42E+02	1.9E+02	20 MIN
AARVC	4L	N/A	--	6.70E-07	13	2400	--	6.00E+02	4.5E+01	20 MIN
AAKHF	5L	0.00E+00	--	N/A	--	3400	--	--	--	--
AAPHC	5L	N/A	--	1.44E-08	57	1498	5.80E+01	1.20E+01	--	24 HR
AAPVC	5L	N/A	--	1.44E-08	57	768	3.00E+01	6.00E+00	--	24 HR
AAQGC	5L	N/A	--	1.44E-08	57	1044	7.20E+01	1.40E+01	--	24 HR
AAQVC	5L	N/A	--	N/A	--	1044	7.20E+01	1.40E+01	--	24 HR
AARGC	5L	N/A	--	1.03E-07	57	642	5.99E+02	4.30E+01	--	24 HR
AARVC	5L	N/A	--	1.03E-07	57	600	5.60E+02	4.00E+01	--	24 HR

APPENDIX J
SUPPORTING INFORMATION FOR HANDLING ANALYSIS

J.1. HANDLING LEAKING M55 ROCKETS

Sources for the information contained in this section are Refs. J-1 and J-2. Table J-1 summarizes handling operations for sending sites while Table J-2 presents operations for receiving sites. Leaking M55 rockets are detected during storage by the igloo monitors or by the hand-held sniffers used by handlers before transporting a pallet. Leakers are isolated in the storage igloo by a two-man team of handlers. Entering the igloo in Level A protective clothing (M-3 TAP suits), the handlers pinpoint the leaker and move its pallet to ground level. They unpack the pallet, removing only those rockets necessary to expose the leaker, and place the removed, nonleaking rockets in a holding fixture.

They spread a plastic sheet on the ground in the area in which the leaker is to be isolated, placing the tools necessary to complete the isolation and the isolation container itself (a PIG) on the sheet. The cover of the PIG is removed, and the leaker is hand-carried to the PIG and placed in it. The cover of the PIG is closed, and its exterior and the tools are decontaminated using sodium carbonate, which is collected in the plastic sheet.

The handlers pick the decontaminated PIG up by its handles, carry it outside and place it on the truck that will carry it to the designated leaker-storage igloo, where it remains until it is transported (two PIGs per pallet) to the demil site. For other PIG operations, the PIG's handlers need wear only Level D protective clothing.

TABLE J-1
HANDLING OPERATIONS TASK ANALYSIS (SENDINC SITES)

Step	Equipment per Person	Error
Pick up munitions and unload outside (igloo/ warehouse apron).	e. fk.	puncture-1 drop-2 collision-1
Load munitions onto truck.	d. fk.	puncture-1 drop-2 collision-1
Transport munitions to maintenance facility (ton containers, mines, cartridges, leaking rockets).	truck	(NA)
Unload munitions from truck at maintenance facility.	d. fk.	drop-2 collision-1 puncture-1
Replace plugs and valves on ton containers.	operator	valve improperly installed. drop-2
Lift up ton layer of drums (containing 3 mines each) after their fuses have been removed and the drums have been placed back on pallet.	operator	drop
Remove propellants from cartridges.	operator	
Leaking rockets placed inside PIGS; PIG is put on pallet.	operator	
Pick up munitions and load onto truck.	d. fk.	drop-2 puncture-1 collision-1
Return munitions to storage (igloo, warehouse).	truck	NA

TABLE J-1 (Continued)

Step	Equipment per Person	Error
Unload munitions from truck (igloo/warehouse apron).	d. fk.	drop-2 puncture-1 collision-1
Place munitions back into storage (igloo, warehouse).	e. fk.	drop-2 puncture-1 collision-1
Pick up munitions in storage and place outside (igloo, warehouse).	e. fk.	drop-2 puncture-1 collision-1
Load munitions and transport to vault.	d. fk.	drop-1 puncture-1 collision-1
Load munitions into vault.	d. fk.	drop-1
Load vault onto truck.	d. fk.	drop-2 collision-1
Transport vault to packing area.	truck	NA
Pick up vault from truck and unload at packing area.	d. fk.	drop-1 collision-1
Place vault inside CAMPACT at packing area.	d. fk.	drop-1
Pick up vault at packing area and load onto truck to take to holding area.	d. fk.	drop-1 collision-1
Transport to holding area.	truck	NA
Unload vault from truck at holding area.	d. fk.	drop-2 collision-1
Pick up vault and load onto train car.	d. fk.	drop-2 collision-1

TABLE J-1 (Continued)

Step	Equipment per Person	Error
Pick up vault from train and unload at holding area.	d. fk.	drop-2 collision-1
Pick up vault at holding area and load onto truck.	d. fk.	drop-2 collision-1
Transport vault to unpacking area.	truck	NA
Unload vault from truck at unpacking area.	d. fk.	drop-2 collision-1
Remove vault from CAMPACT.	d. fk.	drop-2 collision-1
Remove munitions from vault in the packing area.	d. fk.	drop-1 puncture-1
Load munitions onto truck at the packing area.	d. fk.	drop-1 collision-1
Transport munitions to storage area.	truck	NA
Unload munitions from truck outside storage igloo.	d. fk.	drop-2 collision-1 puncture-1
Transfer munitions from outside to the inside of the storage igloo.	e. fk.	drop-2 collision-1 puncture-1
Transfer munitions from inside to outside the storage igloo.	e. fk.	drop-2 puncture-1 collision-1
Load munitions onto truck.	d. fk.	drop-2 puncture-1 collision-1
Transport munitions to MHI.	truck	NA
Unload munitions from truck outside MHI.	d. fk.	drop-2 collision-1 puncture-1

TABLE J-1 (Continued)

Step	Equipment per Person	Error
Pick up munitions outside MHI and place inside.	e. fk.	drop-2 collision-1 puncture-1
Pick up munitions inside MHI and place outside.	e. fk.	drop-2 collision-1 puncture-1
Pick up munitions outside MHI and unload onto conveyor/elevator of MDB.	d. fk.	drop-2 collision-1

J.2. IN-STORAGE DETECTION OF LEAKING M55 ROCKET

To ensure proper packaging for transportation, it is important that leaking M55 rockets be detected before they are placed in vaults so they can be packaged as leakers. Given the overall tendency of the stockpile to leak and the increased tendency of some production lots within the stockpile to leak more often than others, special surveillance measures have been instituted to detect leakers. The likelihood that a leaking rocket is packaged as a nonleaker is a function of the failure of those special measures.

Any time a rocket-storage igloo is entered, first-entry monitoring is performed. This involves taking an air sample to be laboratory-analyzed before entering. If the agent levels exceed acceptable limits, full protective clothing must be worn while entering the igloo and isolating the leaking-rocket. Procedures for handling a leaking M55 rocket are explained in detail in Chapter 8 of Ref. J-1.

Because of their history as leakers, GB rockets are monitored on a regular basis. All igloos holding GB rockets are monitored weekly, while those containing lots made up of known leakers ("leaker lots") are airsampled daily.

In addition, enhanced storage monitoring inspections (SMIs) are conducted quarterly for all rocket igloos. These SMIs include an overall inspection of igloo condition and a 100% visual inspection of all rocket shipping and firing tubes. For the visual inspection, pallets must be moved and dismantled, and individual tubes must be rotated so handlers can observe the whole surface of each. OR For the visual inspection, handlers walk between rows of stacked pallets, observing each pallet and the ground around each pallet for signs of leakage.

During the visual inspection, hand-held "sniffers" are used to check for leaks that can't be seen by the handlers. Also, a statistical sample of each lot is selected for air sampling inside the shipping and firing tubes.

The likelihood that a leaker in the stockpile goes undetected is a function of human errors (Is the monitoring performed correctly and on time?), hardware failures (Does the sniffer function correctly?), and leaker location (Can it be detected where it is, given current monitoring practice?). There are three types of human errors possible: Not monitoring an igloo at all, using the sniffer incorrectly, and overlooking a pallet or row of pallets while monitoring the igloo. Not monitoring an igloo constitutes a failure of administrative control. The administrative controls should be designed to prevent such an omission, but the probability of their not being followed is approximately 10^{-2} (with an error factor of 5) for most cases. Here, because records of igloos' agent levels are retained and because the igloos are most likely monitored in order (and each is too big to miss altogether), the lower bound of 2×10^{-3} is used as a reasonable worst-case estimate for these conditions. Taking 2×10^{-3} as the computed upper bound, the new error probability is estimated as 4×10^{-4}, the likelihood that an igloo is overlooked during the SMI.

Using the sniffer incorrectly implies that the operator has not turned it on, is using an uncalibrated sniffer, is not bringing the sniffer into the range of all potentially leaking pallets, does not notice when a leaker is indicated, etc. Because this check is performed frequently (e.g., GB igloos are monitored weekly), because several dozen pallets are involved in each check, because the monitoring is carried out by a two-man team, and because the leaker-indication alarm is hard to miss, it is estimated that the likelihood of the operator's failing to detect a leaker because of his using the sniffer incorrectly is negligible. This includes his failure to monitor a pallet entirely since the protocol he follows specifies that he will check all pallets

(which he does by walking the pallet aisles in market fashion, checking both sides of each aisle).

The likelihood of a leaker's being detected depends more on equipment reliability than it does on human reliability. If the hand-held sniffers have failed but seem to be in good working order (for example, if they have been miscalibrated), they may not detect a leaker. Also, their sensitivity to leaker position is an important variable. If the leaker is located in the center of a pallet and the pallet is located at the bottom of a stack of pallets, a small leak may not be detected by the sniffer. With little or no airflow in the igloo, the agent vapor may never reach the sniffer (or the igloo sensor). Therefore, the probability of detection is mainly dependent on leaker location and sniffer sensitivity.

J.3. TON CONTAINER VALVE REPLACEMENT

J.3.1. INTRODUCTION

One scenario of interest involves the replacement of existing valves and plugs on ton containers (TCs). For any demilitarization option involving offsite transportation, the valves and the plugs must be replaced by plugs. This calls for handling, movement, and replacement activities on the TCs. There is some probability that the replacement will be made incorrectly, and that the plugs will leak after installation. This discussion addresses that probability.

Valve replacement is different for TCs holding different agents. For TCs of GB, no offsite transportation will be required, and their current valves and plugs (many of which are showing signs of corrosion and some of which have already had to be replaced) will have been replaced with new plugs prior to the start date for the demil operations. Since offsite transportation is not necessary, these new plugs will not have to be replaced again before demilitarization. Therefore, TCs of GB will not be addressed in this analysis.

Before TCs holding either HD or VX can be transported for disposal at a national or regional site, their valves and plugs do have to be replaced. The specifics of this replacement have not been determined, so a generic description of representative activities involved in valve replacement is provided for analysis. Valve replacement does not change any of the assumptions made about TC integrity during transportation or demil.

J.3.2. VALVE-REPLACEMENT ACTIVITIES

TC valve replacement will be performed in situ, no onsite transportation will be necessary. The TCs will be moved by forklift to a clear area on one side of their storage site during replacements, which will be made on one TC at a time. The handlers will wear Level A protective clothing (an M-3 TAP suit) for the operation and will use a TC "cradle," a device designed to hold the TC during valve replacement. The bed of the cradle rotates to move the TC from the horizontal to the vertical and can be locked into position by using a cotter pin to secure a bolt inserted through aligned holes in the frame and the bed.

The TC will be lifted from its stored, horizontal position using a lifting beam attached to a forklift. The forklift will be used to place the TC into the cradle (which should be locked into the horizontal orientation) so that its aft end can be rotated up. The TC will be secured in the cradle by fastening two chains across its girth, from one side of the cradled bed to the other. The bed will be rotated and locked so that the aft end of the TC is vertical. Handlers will use wrenches and taps as necessary to remove existing plugs and replace them with new, steel plugs one at a time. The handlers will work to prespecified torque limits for plug tightening. It may be necessary to rethread the plug holes before the new plugs can be installed.

Following plug installation, the bed of the cradle will be returned to the horizontal, and the TC will be released, lifted using the forklift and lifting beam, and placed and secured in the cradle bed so that its forward end can be rotated up. The bed will be rotated and locked so that the forward end of the TC is vertical. Handlers will use wrenches and taps as necessary to remove existing plugs and replace them with new, steel plugs one at a time. The valves will be removed and will be replaced with new, steel plugs. Handlers will work to prespecified torque limits for plug tightening. It may be necessary to

rethread holes before the new plugs can be installed. The bed will be returned to the horizontal, and the TC will be released, lifted using the forklift and lifting beam, and returned to its storage position.

J.3.3. ERROR IDENTIFICATION

Obviously, it is hoped that the exposure of agent to the air is minimized. This translates operationally into the handlers replacing any removed valves or plugs as quickly as possible. There may be instances, however, when quick (within 10 min) replacement is not achieved. Since these operations involve only HD and VX containers, the consequences of leaving an open port on one end of the container for as long as 10 min are negligible. This is because of the stable nature of those agent under the described conditions and because the cross-section of the TC presents a small surface area of exposure. Even the handlers themselves are not likely to be subjected to significant exposure since their contact with the used valves and plugs (sources of contact contamination) should be brief.

It is possible that, while performing the replacement, the handlers will drop foreign matter (e.g., tools) into the TC. This event has no immediate or future consequences that can be predicted at present, and probably represents a no-cost error. The foreign material will most likely be left in the TC through its demil.

Another potential error involves incorrect installation of the new plugs. The handlers could cross-thread the plug so that a seal is not achieved or they could apply too little or too much torque to the plug. If the plug is cross-threaded or it too little torque is applied, the plug may leak as a result. If the leak is serious, it will be detected when the TC is returned to the horizontal. If the leak is not serious, it could remain undetected for some time, especially if the replugged TCs are stored in the same area where the replacement operations are taking place. Still, it is likely to be small enough to be contained in the lop of the TC. If the surface of the TC is cleaned before or after the valve replacement, even a small leak is likely to be noticed before transport. The joint probability that an installation error is made, that it leads to a leak too small to be detected immediately, and that

the leak is not noticed during the inspection before transport is negligible.

If too much torque is applied to a plug, it will probably not be detected. Neither is it likely to have any adverse effect. This is considered a no-cost error.

J.3.4. CONCLUSION

The factors that characterize TC valve replacement include the agent involved (HD and VX), the time to complete the operation for a single TC (probably less than 30 min), and the replacement parts used (all plugs). These conditions argue for there being no significant risk to the public associated with valve replacement for HD and VX TCs. The risk to the handler is another matter and is discussed in the following section.

J.3.5. SPECIAL HANDLING FIXTURES

At times, it may be necessary to replace TC valves and plugs outside. If an emergency such as a large or obvious leak exists, special equipment has been developed to minimize agent release during the operation. This equipment is a portable glove box designed to be used with the same cradle that is used in normal operations. While the protection afforded the general public in terms of release mitigation may be substantial, the increased risk to the handler may argue against full-time use of the portable glove box.

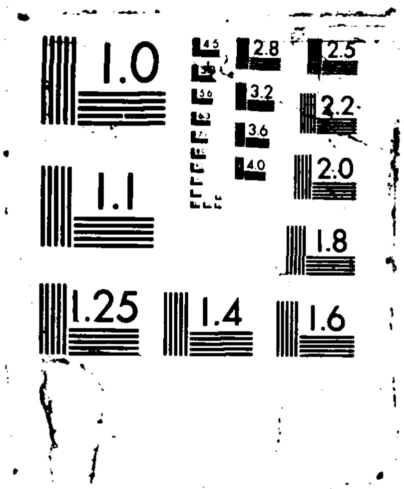
The glove box is a portable shroud that fits over the end of a TC. The shroud is about 18 in. high and its diameter is slightly larger than that of the TC. The bottom edge has a rubber gasket that forms a friction seal with the sides of the TC. The shroud is slipped over the end of the TC until its top is about 12 in. from the valve. The side of the shroud has two discharge vents from which hoses to M-6 filters are connected. The top is 3/8-in. thick sheet of Lexan through which four hand ports have been cut. The M-6 filter fan pulls air through the ports and out the discharge vents, minimizing or eliminating any agent release.

The handlers (who sometimes must stand on a step-platform attached to the cradle to reach the plug and valve assemblies) must access the plugs and valve through the glove box ports. The distance from the valve to the top of the shroud make manipulations difficult, and the limited-access area makes visual contact with the working surface w[illegible] hands are inside difficult. The Lexan itself is prone to scratches. [illegible] the inside is often contaminated with splashes from the operations. These factors also limit visual access.

Working inside a glove-box apparatus while in Level A pr[illegible] clothing makes performing manipulative tasks extremely d[illegible] time to complete each replacement will likely take three [illegible] as it would if the glove box were not used. The handlers [illegible]

AD-A193 355 CHEMICAL STOCKPILE DISPOSAL PROGRAM RISK ANALYSIS OF THE DISPOSAL OF CHEM..(U) GA TECHNOLOGIES INC SAN DIEGO CA A W BARSELL ET AL. AUG 87 GA-C-18563 13/13

UNCLASSIFIED SAPEO-CDE-IS-87006 DAAA15-85-D-0022 F/G 15/6.3 NL


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

will increase their per-operation exposure time. The number of TCs modified during any given crew's shift will, therefore, decrease significantly.

Another area of concern involves the level of protection afforded by the M-3 TAP suit. An examination of the accident and incident data base for chemical munitions operations reveals that, of the measurable worker exposures, the majority were either caused or contributed to by failures of their protective equipment. These failures were themselves the products of equipment failures, errors in administrative control, or undetected damage to the suit during operations. The handlers' lack of visual access to tasks involving the use of sharp tooling and their increased time at the agent release site imply that the use of the portable glove box for valve and plug replacement for the whole TC stockpile may likely be more hazardous for them than if it is not used.

J.4. TRANSPORTATION CONTAINER MONITORING

In estimating the likelihood that a handler will open a transportation container without monitoring its contents for leaks is estimated as 1E-3. This human-error probability is taken from Table 20-22, item 9 (Ref. J-3) and represents a case in which a checker will fail to check equipment status when that status affects the checker's own safety. Since the containers are loaded elsewhere (or at least by other people), the unloading handler should be cautious in dealing with them. Since he has no control over ensuring a "clean" container interior by performing the loading himself, he will probably want to protect himself by making sure he monitors the container before opening it. This error suggests that he will overlook one out of every thousand containers he should monitor.

J.5. REFERENCES

J-1. "Probabilities of Selected Hazards in Disposition of M55 Rockets," M55-CS-02, USATHAMA, September 22, 1985.

J-2. "Transportation of Chemical Agent and Munitions: A Concept Plan," (Preliminary Draft Report for review and comment), USATHAMA, April 3, 1987.

J-3. "Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications," NUREG/CR-1278, U.S. Nuclear Regulatory Commission, May 1983.

☆ U S GOVERNMENT PRINTING OFFICE 1987-2 0 1 - 4 4 2 / 8 0 1 3 9

END
DATE
FILMED
DTIC
JULY 88